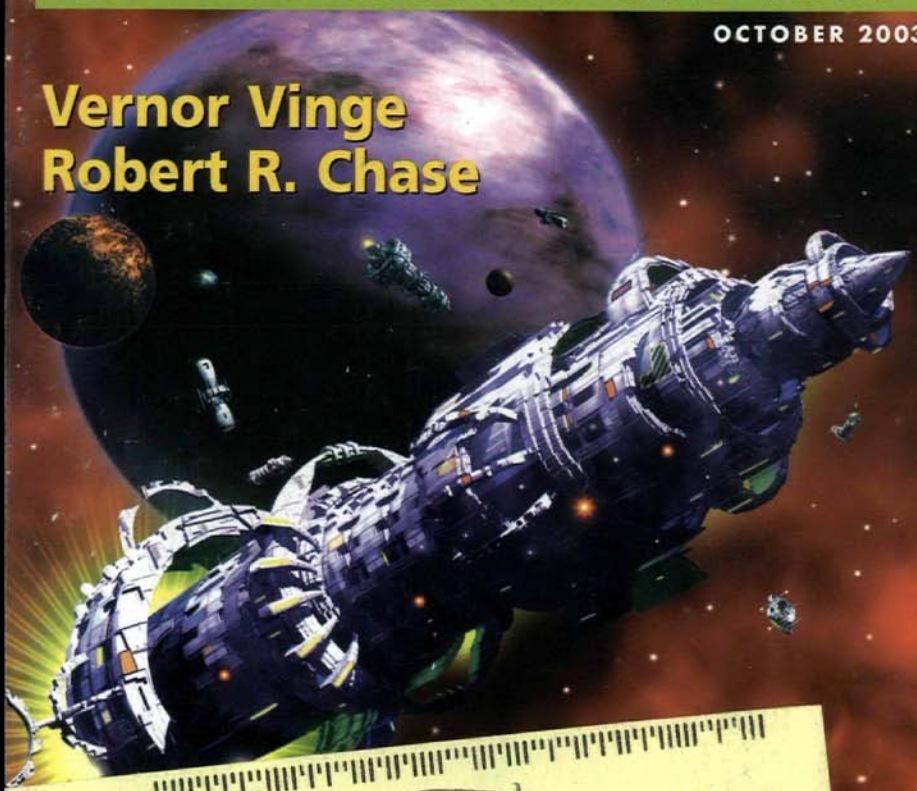
# ANALOG

SCIENCE FICTION AND FACT

OCTOBER 2003

Vernor Vinge

Robert R. Chase



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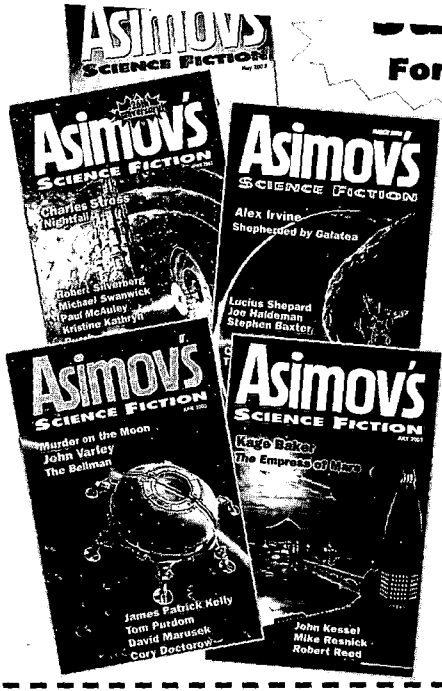


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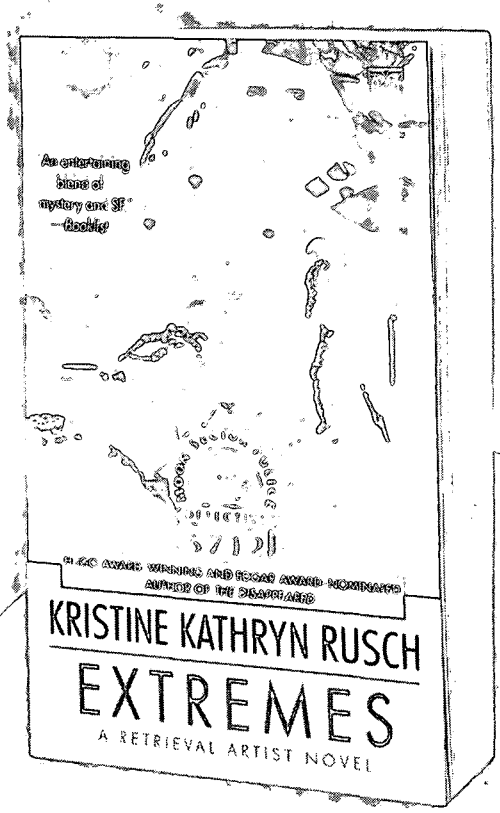
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# ANALOG

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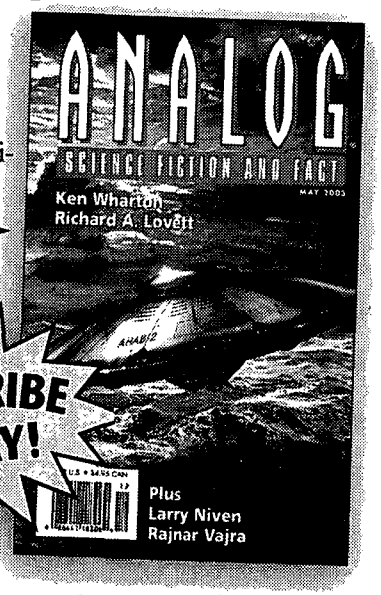


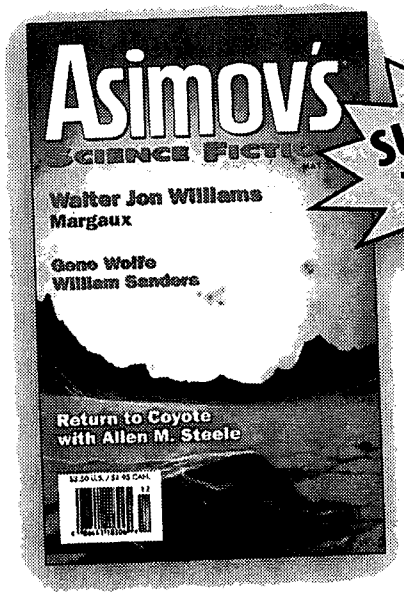


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EDITORIAL Stanley Schmidt

# SCARCE SKILLS AND SCATTERED SUBSTITUTES

What happens when new technology makes old skills unnecessary, but only in certain cases? I've often commented in the past that our rapidly evolving computer technology was leading us to create a culture that can handle information in unprecedentedly powerful ways, but may also be the most ephemeral culture in history. Much of the vast quantity of information being created and processed is stored in formats that are quickly replaced by others, and the old formats become unreadable by new equipment. Thus a great deal of information is recorded, but much of it is effectively lost forever in a very short time.

In "Continuity" (August 1991) I discussed this problem in connection with computers and audio and visual recordings, but I've recently been reminded that something similar can occur even with much older, seemingly more durable storage and processing media. The problem here is that, while printed copies of numerical data or musical scores may last a long time, the practical ability to use them may gradually disappear as it becomes common to process those sorts of information in new ways.

In his short story "The Feeling of Power," Isaac Asimov imagined a future in which everyone had become so completely dependent on computers that they couldn't imagine computing without them—and when someone learned how to do so, it began a revolution. Isaac told me once that he imagined the story to be set some six hundred years in the future, but in less than fifteen years I saw something very much like it already happening as electronic calculators swept slide rules out of physics classrooms and computers replaced cash registers in stores.

It wouldn't have happened if the new electronic tools didn't have powerful strengths—as a professor, I did like finally being able to give realistic decibel problems to music majors studying acoustics—but they have drawbacks, too. Most of these involve dependence of one sort or another. People quickly started forgetting how to do even simple arithmetic without electronic aids. I've seen pizza clerks claim seriously that they couldn't make change because "the computer is down," and physics students be off by 130 orders of magnitude and not realize anything was wrong because it never occurred to them to do the sort of mental approximation they always used to place the decimal point in a slide rule result. Now, of course, such tools are extremely widespread, and on the whole extremely useful—as long as the infrastructure on which they depend is up and running.

Now let's consider another case involving science and the arts. Explaining it requires a fair amount of background, so I'll sneak up on it. Please bear with me.

The ways human beings do things often arise by evolution—a series of incremental changes in earlier ways—with the result that the generally accepted practice at a particular time may not appear to make sense unless you under-



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stand how it got that way. Symphony orchestras play a wide variety of music from the last several centuries, and, at least until recently, the musicians normally read their parts from the composer's original music or direct copies of it. Some families of instruments are called "transposing" instruments because they are written in one key but actually sound in another. This may sound bizarre, but the practice originally arose as a convenience for players.

For some groups of instruments, it still is a convenience. Saxophones, for instance, come in several sizes: alto in E-flat, tenor in B-flat, and baritone in E-flat (an octave lower than the alto) are all in common use; soprano and bass versions are rarer, but exist. When I say that a tenor sax is "in B-flat," I mean that when you play a "C" in music written for that instrument, what actually comes out (the "concert pitch") is a B-flat a full tone (or, in this case, a ninth) lower. All notes on a given instrument are transposed by the same interval. The advantage of the system is that a sax player can learn one set of fingerings and apply it directly to any member of the saxophone family, instead of having to learn a different set of fingerings for each size of instrument.

The same principle applies to clarinets: E-flat and B-flat soprano, E-flat alto, and B-flat bass clarinets are in more or less common use, and a player who learns to play one of them already knows the fingerings to play any of the others from parts written for them. But clarinets also illustrate another advantage of families of transposing instruments. If you take binoculars to a symphony concert and watch the clarinetists closely, you'll often see that each of them comes onstage with two almost identical clarinets, and occasionally switches back and forth between them. They're pitched in A and B-flat, a mere half-tone apart, so why bother? The reason is that clarinetists are often expected to be quite agile, and some fingering patterns are much easier than others. The fingering for what clarinetists are taught as a "C" scale, for example, is quite simple and easy, while that for a "B" scale is complicated, awkward, and hard to execute quickly. But a "C" scale played on an A clarinet is exactly the same notes (a concert A scale) as a "B" scale on a B-flat instrument. So a considerate composer will often score a piece in the key of A for an A clarinet, and the player who has one will find it much easier to play than if he had to do it on a B-flat instrument. As a rough rule of thumb, passages in "sharp" keys are easier on an A clarinet, and those in "flat" keys are easier on a B-flat. Of course, a player who has only one clarinet, as many younger or less affluent players do, will sometimes have to contend not only with awkward fingerings, but simultaneously with mentally transposing every note of the part.

That predicament is often faced by brass players, where the historical situa-

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tion is a bit different. Before valves were invented, less than two hundred years ago, trumpets and horns (except in very high parts of their ranges) could only play a few more or less widely spaced notes that more or less defined a single key. A composer writing a passage in C could give the trumpeter some notes that contributed useful things to the overall effect, but the player had to use a "trumpet in C." If he wanted to play a similar part in a piece in F or G, he had to change to a trumpet in F or G, either by switching to a whole new instrument, or by replacing a removable part of his trumpet (a "crook") with a corresponding one of a different length. As long as the player had a complete enough set of instruments (or crooks), the easiest way to teach him to play all of them was to write for them, and teach him to read parts, as if they were all in C.

Valves changed everything—except old parts. With valves, players could play much more complicated music, using any note within their range (even sharps and flats!), and they could do it in any key. To a considerable extent, that made it unnecessary for a trumpeter to use more than one instrument. Of course, that doesn't mean that trumpets were immediately standardized to a single size and design, any more than all computers standardized on a single operating system as soon as one was invented. Early manufacturers experimented with lots of variations on the valved trumpet, including models pitched in different keys. But over a few decades, most of them were winnowed out, and by our time, a large majority of trumpeters were using only B-flat trumpets, sounding one full tone lower than written.

True, some professionals and serious, advanced amateurs still use C or D trumpets, or piccolo trumpets in B-Flat or A for the particularly high parts found in much Baroque music and Ravel's "Bolero." Those who have multiple types often decide which one to use not for ease of reading, but for subtle differences in sound quality. And most players *don't* have multiple types. Most players go through years of study owning only a B-flat trumpet, and believing that they simply play what's written and don't have to think about the fact that what comes out is a tone lower.

If such a player joins a symphony orchestra, he or she is likely to get a rude shock. A great many symphonic parts are written for trumpets in keys other than B-flat. Some are commoner than others, but I've seen almost everything

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possible: C, D-flat, D, E-flat, E, F, G, A-flat, A, and even H (which is what Germans, for reasons known only to themselves, often call B-natural). Playing such a part on a B-flat trumpet requires mentally transposing every note, and by a different interval for every key of transposition.

This is *hard*, for somebody who's never done it before. A system that started out to make life easier for players of one period has become a disadvantage, a seemingly unnecessary obstacle, for those of our period. The difficulty goes away and the process becomes automatic if you get enough practice at doing it, but that can take weeks, months, or years. It's no difficulty at all for an experienced pro, but it's definitely intimidating for the inexperienced. I've seen several players come to one rehearsal of an ambitious amateur orchestra, gasp, "You want me to do *what*?" and disappear, never to return. This is a common and significant problem. Full-time professional orchestras are so expensive to run that they're scarce, so semiprofessional and amateur orchestras are an important part of the overall music scene. Not only do they provide the only source of live classical music in many areas, but even those who will eventually populate the major professional orchestras often gain experience first with amateur and semi-pro groups.

Recently I've noticed a new trend, evidently motivated by a desire to make old music more accessible to more modern players by eliminating the need for transposition. Many old pieces have lately been reissued in new editions with the trumpet parts both in the original notation and transposed for B-flat trumpet. I suspect this is a result of new music notation technology. In the past, providing a transposed part along the original would have required someone to manually engrave a whole new part, quite possibly introducing transposition errors in the process. Now software analogous to word processors makes it much easier. To set a new part, you just key in appropriate commands and a computer makes appropriate marks on the score, very easily and accurately. It only takes a couple of mouse clicks to make another version automatically transposed for trumpet in B-flat (or any other key you'd like).

This certainly makes life easier for players who haven't done enough transposition to be comfortable with it, but is it entirely a good thing? I've noticed that even excellent players without much transposition experience tend to go straight for the transposed part, thereby avoiding getting the experience that would make them fluent and comfortable with transposing when they have to. I can easily extrapolate the trend to a time when players don't have printed parts at all. Instead of a music stand, each will have a computer display that shows his part in whatever key he or she would like to read it in. The conductor, who has the whole score stored electronically, will even be able to click his directorial mouse and instantly transpose *everybody's* part to play an entire piece in a different key—for example, to accommodate the preference of a singer with limited range.

What will be the effect of all this? Who will still learn to transpose? Does it matter if anybody does? Wouldn't it be an improvement just to relegate the whole silly, cumbersome process to the proverbial dustbin of history?

Well, maybe it would—*if* we could reasonably expect *all* music written the old way to be republished in the new. Realistically, though, that is unlikely to happen. I can easily imagine a future in which hardly anybody learns to transpose and a lot of worthwhile music will cease to be played, and fade into oblivion, simply because nobody bothered to republish it in "dummy" editions for players who can't read it the way it was written.

And that, I suspect, will be a significant and regrettable loss. ■



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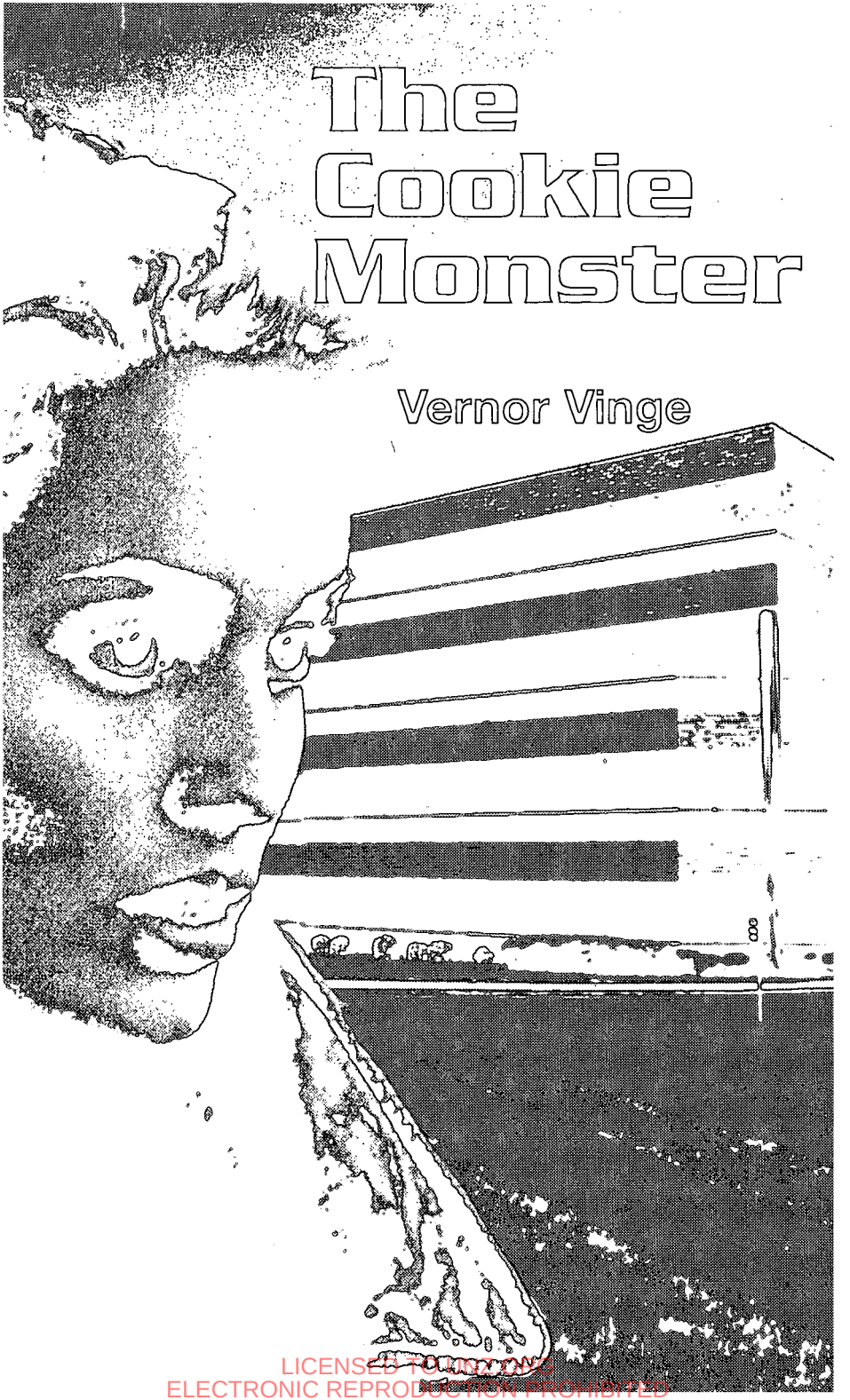
# The Cookie Monster

Vernor Vinge



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Man is "the time-binding animal." But in the future, that simple statement may take on meanings that Korzybski never imagined. . . .

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"So how do you like the new job?"

Dixie Mae looked up from her keyboard and spotted a pimply face peering at her from over the cubicle partition.

"It beats flipping burgers, Victor," she said.

Victor bounced up so his whole face was visible. "Yeah? It's going to get old awfully fast."

Actually, Dixie Mae felt the same way. But doing customer support at LotsaTech was a real job, a foot in the door at the biggest high-tech company in the world. "Gimme a break, Victor! This is our first day." Well, it was the first day not counting the six days of product familiarization classes. "If you can't take this, you've got the attention span of a cricket."

"That's a mark of intelligence, Dixie Mae. I'm smart enough to know what's not worth the attention of a first-rate creative mind."

*Grr.* "Then your first-rate creative mind is going to be out of its gourd by the end of the summer."

Victor smirked. "Good point." He thought a second, then continued more quietly, "But see, um, I'm doing this to get material for my column in the *Bruin*. You know, big headlines like 'The New Sweatshops' or 'Death by Boredom'. I haven't decided whether to play it for laughs or go for heavy social consciousness. In any case,"—he lowered his voice another notch—"I'm bailing out of here, um, by the end of next week, thus suffering only minimal brain damage from the whole sordid experience."

"And you're not seriously helping the customers at all, huh, Victor? Just giving them hilarious misdirections?"

Victor's eyebrows shot up. "I'll have you know I'm being articulate and seriously helpful . . . at least for another day or two." The weasel grin crawled back onto his face. "I won't start being Bastard Consultant from Hell till right before I quit."

*That figures.* Dixie Mae turned back to her keyboard. "Okay, Victor. Meantime, how about letting me do the job I'm being paid for?"

Silence. Angry, insulted silence? No, this was more a leering, undressing-you-with-my-eyes silence. But Dixie Mae did not look up. She could tolerate such silence as long as the leerer was out of arm's reach.

After a moment, there was the sound of Victor dropping back into his chair in the next cubicle.

Ol' Victor had been a pain in the neck from the get-go. He was slick with words; if he wanted to, he could explain things as good as anybody Dixie Mae had ever met. At the same time, he kept rubbing it in how educated he was and what a dead-end this customer support gig was. Mr. Johnson—the guy running the familiarization course—was a great teacher, but smart-ass Victor had tested the man's patience all week long. Yeah, Victor really didn't belong here, but not for the reasons he bragged about.

It took Dixie Mae almost an hour to finish off seven more queries. One took some research, being a really bizarre question about Voxalot for Norwegian. Okay, this job would get old after a few days, but there was a virtuous feeling in helping people. And from Mr. Johnson's lectures, she knew that as long as she got the reply turned in by closing time this evening, she could spend the whole afternoon researching just how to make LotsaTech's vox program recognize Norwegian vowels.

Dixie Mae had never done customer support before this; till she took Prof. Reich's tests last week, her highest-paying job really had been flipping burgers. But like the world and your Aunt Sally, she had often been the *victim* of customer support. Dixie Mae would buy a new book or a cute dress, and it would break or wouldn't fit—and then when she wrote customer support, they wouldn't reply, or had useless canned answers, or just tried to sell her some-



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thing more—all the time talking about how their greatest goal was serving the customer.

But now LotsaTech was turning all that around. Their top bosses had realized how important real humans were to helping real human customers. They were hiring hundreds and hundreds of people like Dixie Mae. They weren't paying very much, and this first week had been kinda tough since they were all cooped up here during the crash intro classes.

But Dixie Mae didn't mind. "LotsaTech is a lot of Tech." Before, she'd always thought that motto was stupid. But LotsaTech was *big*; it made IBM and Microsoft look like minnows. She'd been a little nervous about that, imagining that she'd end up in a room bigger than a football field with tiny office cubicles stretching away to the horizon. Well, Building 0994 did have tiny cubicles, but her team was just fifteen nice people—leaving Victor aside for the moment. Their work floor had windows all the way around, a panoramic view of the Santa Monica mountains and the Los Angeles basin. And li'l ol' Dixie Mae Leigh had her a desk right beside one of those wide windows! *I'll bet there are CEO's who don't have a view as good as mine.* Here's where you could see a little of what the Lotsa in LotsaTech meant. Just outside of B0994 there were tennis courts and a swimming pool. Dozens of similar buildings were scattered across the hillside. A golf course covered the next hill over, and more company land lay beyond that. These guys had the money to buy the top off Runyon Canyon and plunk themselves down on it. And this was just the LA branch office.

Dixie Mae had grown up in Tarzana. On a clear day in the valley, you could see the Santa Monica mountains stretching off forever into the haze. They seemed beyond her reach, like something from a fairy tale. And now she was up here. Next week, she'd bring her binoculars to work, go over on the north slope, and maybe spot where her father still lived down there.

Meanwhile, back to work. The next six queries were easy, from people who hadn't even bothered to read the single page of directions that came with Voxalot. Letters like those would be hard to answer politely the thousandth time she saw them. But she would try—and today she practiced with cheerful specifics that stated the obvious and gently pointed the customers to where they could find more. Then came a couple of brain twisters. Damn. She wouldn't be able to finish those today. Mr. Johnson said "finish anything you start on the same day"—but maybe he would let her work on those first thing Monday morning. She really wanted to do well on the hard ones. Every day, there would be the same old dumb questions. But there would also be hard new questions. And eventually she'd get really, really good with Voxalot. More important, she'd get good about managing questions and organization. So what that she'd screwed the last seven years of her life and never made it through college? Little by little she would improve herself, till a few years from now her past stupidities wouldn't matter anymore. Some people had told her that such things weren't possible nowadays, that you really needed the college degree. But people had always been able to make it with hard work. Back in the twentieth century, lots of steno pool people managed it. Dixie Mae figured customer support was pretty much the same kind of starting point.

Nearby, somebody gave out a low whistle. Victor. Dixie Mae ignored him.

"Dixie Mae, you gotta see this."

*Ignore him.*

"I swear Dixie, this is a first. How did you do it? I got an incoming query for *you*, by name! Well, almost."

"What!? Forward it over here, Victor."

"No. Come around and take a look. I have it right in front of me."



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Dixie Mae was too short to look over the partition. *Jeez.*

Three steps took her into the corridor. Ulysse Green poked her head out of her cubicle, an inquisitive look on her face. Dixie Mae shrugged and rolled her eyes, and Ulysse returned to her work. The sound of fingers on keys was like occasional raindrops (no Voxalots allowed in cubicle-land). Mr. Johnson had been around earlier, answering questions and generally making sure things were going okay. Right now he should be back in his office on the other side of the building; this first day, you hardly needed to worry about slackers. Dixie Mae felt a little guilty about making that a lie, but . . .

She popped into Victor's cubicle, grabbed a loose chair. "This better be good, Victor."

"Judge for yourself, Dixie Mae." He looked at his display. "Oops, I lost the window. Just a second." He dinked around with his mouse. "So, have you been putting your name on outgoing messages? That's the only way I can imagine this happening—"

"No. I have not. I've answered twenty-two questions so far, and I've been AnnetteG all the way." The fake signature was built into her "send" key. Mr. Johnson said this was to protect employee privacy and give users a feeling of continuity even though follow-up questions would rarely come to the original responder. He didn't have to say that it was also to make sure that LotsaTech support people would be interchangeable, whether they were working out of the service center in Lahore or Londonderry—or Los Angeles. So far, that had been one of Dixie Mae's few disappointments about this job; she could never have an ongoing helpful relationship with a customer.

So what the devil was this all about?

"Ah! Here it is." Victor waved at the screen. "What do you make of it?"

The message had come in on the help address. It was in the standard layout enforced by the query acceptance page. But the "previous responder field" was not one of the house sigs. Instead it was:

Ditzie May Lay

"Grow up, Victor."

Victor raised his hands in mock defense, but he had seen her expression, and some of the smirk left his face. "Hey, Dixie Mae, don't kill the messenger. This is just what came in."

"No way. The server-side script would have rejected an invalid responder name. You faked this."

For a fleeting moment, Victor looked uncertain. *Hah!* thought Dixie Mae. She had been paying attention during Mr. Johnson's lectures; she knew more about what was going on here than Victor-the-great-mind. And so his little joke had fallen flat on its rear end. But Victor regrouped and gave a weak smile. "It wasn't me. How would I know about this, er, nickname of yours?"

"Yes," said Dixie Mae, "it takes real genius to come up with such a clever play on words."

"Honest, Dixie Mae, it wasn't me. Hell, I don't even know how to use our form editor to revise header fields."

Now *that* claim had the ring of truth.

"What's happening?"

They looked up, saw Ulysse standing at the entrance to the cubicle.

Victor gave her a shrug. "It's Dit—Dixie Mae. Someone here at LotsaTech is jerking her around."

Ulysse came closer and bent to read from the display. "Yech. So what's the message?"

Dixie Mae reached across the desk and scrolled down the display. The return address was lusting925@freemail.sg. The topic choice was "Voice Formatting." They got lots on that topic; Voxalot format control wasn't quite as intuitive as the ads would like you to believe.

But this was by golly *not* a follow-up on anything Dixie Mae had answered:



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. . .

Hey there, Honey Chile! I'll be truly grateful if you would tell me how to put the following into italics:

"Remember the Tarzanarama tree house? The one you set on fire? If you'd like to start a much bigger fire, then figure out how I know all this. A big clue is that 999 is 666 spelled upside down."

I've tried everything and I can't set the above proposition into indented italics—leastwise without fingering. Please help.

Aching for some of your Southron Hospitality, I remain your very bestest fiend,

—Lusting (for you deeply)

Ulysse's voice was dry: "So, Victor, you've figured how to edit incoming forms."

"God damn it, I'm innocent!"

"Sure you are." Ulysse's white teeth flashed in her black face. The three little words held a world of disdain.

Dixie Mae held up her hand, waving them both to silence. "I . . . don't know. There's something real strange about this mail." She stared at the message body for several seconds. A big ugly chill was growing in her middle. Mom and Dad had built her that tree house when she was seven years old. Dixie Mae had loved it. For two years she was Tarzana of Tarzana. But the name of the tree house—Tarzanarama—had been a secret. Dixie Mae had been nine years old when she torched that marvelous tree house. It had been a terrible accident. Well, a world-class temper tantrum, actually. But she had never meant the fire to get so far out of control. The fire had darn near burned down their real house, too. She had been a scarifyingly well-behaved little girl for almost two years after that incident.

Ulysse was giving the mail a careful read. She patted Dixie Mae on the shoulder. "Whoever this is, he certainly doesn't sound friendly."

Dixie Mae nodded. "This weasel is pushing every button I've got." Including her curiosity. Dad was the only living person that knew who had started the fire, but it was going on four years since he'd had any address for his daughter—and Daddy would never have taken this sex-creep, disrespecting tone.

Victor glanced back and forth between them, maybe feeling hurt that he was no longer the object of suspicion. "So who do you think it is?"

Don Williams craned his head over the next partition. "Who is what?"

Given another few minutes, and they'd have everyone on the floor with some bodily part stuck into Victor's cubicle.

Ulysse said, "Unless you're deaf, you know most of it, Don. Someone is messing with us."

"Well then, report it to Johnson. This is our first day, people. It's not a good day to get sidetracked."

That brought Ulysse down to earth. Like Dixie Mae, she regarded this LotsaTech job as her last real chance to break into a profession.

"Look," said Don. "It's already lunch time."—Dixie Mae glanced at her watch. It really was!—"We can talk about this in the cafeteria, then come back and give Great Lotsa a solid afternoon of work. And then we'll be done with our first week!" Williams had been planning a party down at his folks' place for tonight. It would be their first time off the LotsaTech campus since they took the job.

"Yeah!" said Ulysse. "Dixie Mae, you'll have the whole weekend to figure out who's doing this—and plot your revenge."

Dixie Mae looked again at the impossible "previous responder field." "I . . . don't know. This looks like it's something happening right here on the LotsaTech campus." She stared out Victor's picture window. It was the same view as from her cubicle, of course—but now she was seeing everything with a different mind set. Somewhere in the beautiful country-club buildings, there was a



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real sleaze ball. And he was playing guessing games with her.

Everybody was quiet for a second. Maybe that helped—Dixie Mae realized just what she was looking at: the next lodge down the hill. From here you could only see the top of its second story. Like all the buildings on the campus, it had a four-digit identification number made of gold on every corner. That one was Building 0999.

*A big clue is that 999 is just 666 spelled upside down.* "Jeez, Ulysse. Look: 999." Dixie Mae pointed down the hillside.

"It could be a coincidence."

"No, it's too pat." She glanced at Victor. This really was the sort of thing someone like him would set up. *But whoever wrote that letter just knew too much.* "Look, I'm going to skip lunch today and take a little walk around the campus."

"That's crazy," said Don. "LotsaTech is an open place, but we're not supposed to be wandering into other project buildings."

"Then they can turn me back."

"Yeah, what a great way to start out with the new job," said Don. "I don't think you three realize what a good deal we have here. I know that none of you have worked a customer support job before." He looked around challengingly. "Well I have. This is heaven. We've got our own friggin' offices, onsite tennis courts and health club. We're being treated like million-dollar system designers. We're being given all the time we need to give top-notch advice to the customers. What LotsaTech is trying to do here is revolutionary! And you dips are just going to piss it away." Another all-around glare. "Well, do what you want, but I'm going to lunch."

There was a moment of embarrassed silence. Ulysse stepped out of the cubicle and watched Don and others trickle away toward the stairs. Then she was back. "I'll come with you, Dixie Mae, but . . . have you thought Don may be right? Maybe you could just postpone this till next week?" Unhappiness was written all over her face. Ulysse was a lot like Dixie Mae, just more sensible.

Dixie Mae shook her head. She figured it would be at least fifteen minutes before her common sense could put on the brakes.

"I'll come, Dixie Mae," said Victor. "Yeah. . . . This could be an interesting story."

Dixie Mae smiled at Ulysse and reached out her hand. "It's okay, Ulysse. You should go to lunch." The other looked uncertain. "Really. If Mr. Johnson asks about me missing lunch, it would help if you were there to set him right about what a steady person I am."

"Okay, Dixie Mae. I'll do that." She wasn't fooled, but this way it really was okay.

Once she was gone, Dixie Mae turned back to Victor. "And you. I want a printed copy of that freakin' email."

They went out a side door. There was a soft-drink and candy machine on the porch. Victor loaded up on "expeditionary supplies" and the two started down the hill.

"Hot day," said Victor, mumbling around a mouth full of chocolate bar.

"Yeah." The early part of the week had been all June Gloom. But the usual overcast had broken, and today was hot and sunny—and Dixie Mae suddenly realized how pleasantly air-conditioned life had been in the LotsaTech "sweatshop." Common sense hadn't yet reached the brakes, but it was getting closer.

Victor washed the chocolate down with a Dr. Fizzz and flipped the can behind the oleanders that hung close along the path. "So who do you think is behind that letter? Really?"

"I don't *know*, Victor! Why do you think I'm risking my job to find out?"

Victor laughed. "Don't worry about losing the job, Dixie Mae. Heh. There's no way it could have lasted even



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through the summer." He gave his usual superior-knowledge grin.

"You're an idiot, Victor. Doing customer support *right* will be a billion dollar winner."

"Oh, maybe . . . if you're on the right side of it." He paused as if wondering what to tell her. "But for you, look: support costs money. Long ago, the Public Spoke about how much they were willing to pay." He paused, like he was trying to put together a story that she could understand. "Yeah . . . and even if you're right, your vision of the project is doomed. You know why?"

Dixie Mae didn't reply. His reason would be something about the crappy quality of the people who had been hired.

Sure enough, Victor continued: "I'll tell you why. And this is the surprise kink that's going to make my articles for the *Bruin* really shine: Maybe LotsaTech has its corporate heart in the right place. That would be surprising considering how they brutalized Microsoft. But maybe they've let this bizarre idealism go too far. Heh. For anything long-term, they've picked the wrong employees."

Dixie Mae kept her cool. "We took all sorts of psych tests. You don't think Professor Reich knows what he's doing?"

"Oh, I bet he knows what he's doing. But what if LotsaTech isn't using his results? Look at us. There are some—such as yours truly—who are way over-educated. I'm closing in on a master's degree in journalism; it's clear I won't be around for long. Then there's people like Don and Ulysse. They have the right level of education for customer support, but they're too smart. Yes, Ulysse talks about doing this job so well that her talent is recognized, and she is a diligent sort. But I'll bet that even she couldn't last a summer. As for some of the others . . . well, may I be frank, Dixie Mae?"

What saved him from a fist in the face was that Dixie Mae had never managed to be really angry about more than one thing at once. "Please *do* be frank, Victor."

"You talk the same game plan as Ulysse—but I'll bet your multiphasic shows you have the steadiness of mercury fulminate. Without this interesting email from Mr. Lusting, you might be good for a week, but sooner or later you'd run into something so infuriating that direct action was required—and you'd be bang out on your rear."

Dixie Mae pretended to mull this over. "Well, yes," she said. "After all, you're still going to be here next week, right?"

He laughed. "I rest my case. But seriously, Dixie Mae, this is what I mean about the personnel situation here. We have a bunch of bright and motivated people, but their motivations are all over the map, and most of their enthusiasm can't be sustained for any realistic span of time. Heh. So I guess the only rational explanation—and frankly, I don't think it would work—is that LotsaTech figures . . ."

He droned on with some theory about how LotsaTech was just looking for some quick publicity and a demonstration that high-quality customer support could win back customers in a big way. Then after they flushed all these unreliable new hires, they could throttle back into something cheaper for the long term.

But Dixie Mae's attention was far away. On her left was the familiar view of Los Angeles. To her right, the ridgeline was just a few hundred yards away. From the crest you could probably see down into the valley, even pick out streets in Tarzana. Someday, it would be nice to go back there, maybe prove to Dad that she could keep her temper and make something of herself. *All my life, I've been screwing up like today.* But that letter from "Lusting" was like finding a burglar in your bedroom. The guy knew too much about her that he shouldn't have known, and he had mocked her background and her family. Dixie Mae had grown up in Southern California, but she'd been born in Geor-



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gia—and she was proud of her roots. Maybe Daddy never realized that, since she was running around rebelling most of the time. He and Mom always said she'd eventually settle down. But then she fell in love with the wrong kind of person—and it was her folks who'd gone ballistic. Words Were Spoken. And even though things hadn't worked out with her new love, there was no way she could go back. By then Mom had died. Now, *I swear I'm not going back to Daddy till I can show I've made something of myself.*

So why was she throwing away her best job in ages? She slowed to a stop, and just stood there in the middle of the walkway; common sense had finally gotten to the brakes. But they had walked almost all the way to 0999. Much of the building was hidden behind twisty junipers, but you could see down a short flight of stairs to the ground level entrance.

*We should go back.* She pulled the "Lusting" email out of her pocket and glared at it for a second. *Later. You can follow up on this later.* She read the mail again. The letters blurred behind tears of rage, and she dithered in the hot summer sunlight.

Victor made an impatient noise. "Let's go, kiddo." He pushed a chocolate bar into her hand. "Get your blood sugar out of the basement."

They went down the concrete steps to B0999's entrance. *Just a quick look*, Dixie Mae had decided.

Beneath the trees and the overhang, all was cool and shady. They peered through the ground floor windows, into empty rooms. Victor pushed open the door. The layout looked about the same as in their own building, except that B0999 wasn't really finished: There was the smell of Carpenter Nail in the air, and the lights and wireless nodes sat naked on the walls.

The place was occupied. She could hear people talking up on the main floor, what was cubicle-city back in B0994. She took a quick hop up the stairs, peeked in—no cubicles here. As a result, the place looked cavernous. Six or eight tables had been pushed together in the middle of the room. A dozen people looked up at their entrance.

"Aha!" boomed one of them. "More warm bodies. Welcome, welcome!"

They walked toward the tables. Don and Ulysse had worried about violating corporate rules and project secrecy. They needn't have bothered. These people looked almost like squatters. Three of them had their legs propped up on the tables. Junk food and soda cans littered the tables.

"Programmers?" Dixie Mae muttered to Victor.

"Heh. No, these look more like . . . graduate students."

The loud one had red hair snatched back in a pony tail. He gave Dixie Mae a broad grin. "We've got a couple of extra display flats. Grab some seating." He jerked a thumb toward the wall and a stack of folding chairs. "With you two, we may actually be able to finish today!"

Dixie Mae looked uncertainly at the display and keyboard that he had just lit up. "But what—"

"Cognitive Science 301. The final exam. A hundred dollars a question, but we have 107 bluebooks to grade, and Gerry asked mainly essay questions."

Victor laughed. "You're getting a hundred dollars for each bluebook?"

"For each question in each bluebook, man. But don't tell. I think Gerry is funding this out of money that LotsaTech thinks he's spending on research." He waved at the nearly empty room, in this nearly completed building.

Dixie Mae leaned down to look at the display, the white letters on a blue background. It was a standard bluebook, just like at Valley Community College. Only here the questions were complete nonsense, such as:

7. COMPARE AND CONTRAST COGNITIVE DIS-



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SONANCE IN OPERANT CONDITIONING WITH MINSKY-LOÈVE ATTENTION MAINTENANCE. OUTLINE AN ALGORITHM FOR CONSTRUCTING THE ASSOCIATED ISOMORPHISM.

"So," said Dixie Mae, "what's cognitive science?"

The grin disappeared from the other's face. "Oh, Christ. You're not here to help with the grading?"

Dixie Mae shook her head. Victor said, "It shouldn't be too hard. I've had some grad courses in psych."

The redhead did not look encouraged. "Does anyone know this guy?"

"I do," said a girl at the far end of all the tables. "That's Victor Smaley. He's a journalism grad, and not very good at that."

Victor looked across the tables. "Hey, Mouse! How ya doing?"

The redhead looked beseechingly at the ceiling. "I do not need these distractions!" His gaze came down to the visitors. "Will you two just please go away?"

"No way," said Dixie Mae. "I came here for a reason. Someone—probably someone here in Building 0999—is messing with our work in Customer Support. I'm going to find out who." *And give them some free dental work.*

"Look. If we don't finish grading the exam today, Gerry Reich's going to make us come back tomorrow and—"

"I don't think that's true, Graham," said a guy sitting across the table. "Prof. Reich's whole point was that we should not feel time pressure. This is an experiment, comparing time-bounded grading with complete individualization."

"Yes!" said Graham the redhead. "That's exactly why Reich would lie about it. 'Take it easy, make good money,' he says. But I'll bet that if we don't finish today, he'll screw us into losing the weekend."

He glared at Dixie Mae. She glared back. Graham was going to find out just what stubborn and willful really meant. There was a moment of silence and then—

"I'll talk to them, Graham." It was the woman at the far end of the tables.

"Argh. Okay, but not here!"

"Sure, we'll go out on the porch." She beckoned Dixie Mae and Victor to follow her out the side door.

"And hey," called Graham as they walked out, "don't take all day, Ellen. We need you here."

The porch on 0999 had a bigger junk-food machine than back at Customer Support. Dixie Mae didn't think that made up for no cafeteria, but Ellen Garcia didn't seem to mind. "We're only going to be here this one day. *I'm* not coming back on Saturday."

Dixie Mae bought herself a sandwich and soda and they all sat down on some beat-up lawn furniture.

"So what do you want to know?" said Ellen.

"See, Mouse, we're following up on the weirdest—"

Ellen waved Victor silent, her expression pretty much the same as all Victor's female acquaintances. She looked expectantly at Dixie Mae.

"Well, my name is Dixie Mae Leigh. This morning we got this email at our customer support address. It looks like a fake. And there are things about it that—" she handed over the hard copy.

Ellen's gaze scanned down. "Kind of fishy dates," she said to herself. Then she stopped, seeing the "To:" header. She glanced up at Dixie Mae. "Yeah, this is abuse. I used to see this kind of thing when I was a Teaching Assistant. Some guy would start hitting on a girl in my class." She eyed Victor speculatively.

"Why does everybody suspect me?" he said.

"You should be proud, Victor. You have such a reliable reputation." She shrugged. "But actually, this isn't quite your style." She read on. "The rest is smirky lascivious, but otherwise it doesn't mean anything to me."

"It means a lot to *me*," said Dixie Mae. "This guy is talking about things that no-



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body should know."

"Oh?" She went back to the beginning and stared at the printout some more. "I don't know about secrets in the message body, but one of my hobbies is rfc9822 headers. You're right that this is all scammed up. The message number and ident strings are too long; I think they may carry added content."

She handed back the email. "There's not much more I can tell you. If you want to give me a copy, I could crunch on those header strings over the weekend."

"Oh. . . . Okay, thanks." It was more solid help than anyone had offered so far, but—"Look Ellen, the main thing I was hoping for was some clues here in Building 0999. The letter pointed me here. I run into . . . abusers sometimes, myself. I don't let them get away with it! I'd bet money that whoever this is, he's one of those graders." *And he's probably laughing at us right now.*

Ellen thought a second and then shook her head. "I'm sorry, Dixie Mae. I know these people pretty well. Some of them are a little strange, but they're not bent like this. Besides, we didn't know we'd be here till yesterday afternoon. And today we haven't had time for mischief."

"Okay," Dixie Mae forced a smile. "I appreciate your help." She would give Ellen a copy of the letter and go back to Customer Support, just slightly better off than if she had behaved sensibly in the first place.

Dixie Mae started to get up, but Victor leaned forward and set his notepad on the table between them. "That email had to come from somewhere. Has anyone here been acting strange, Mousy?"

Ellen glared at him, and after a second he said, "I mean 'Ellen.' You know I'm just trying to help out Dixie Mae here. Oh yeah, and maybe get a good story for the *Bruin*."

Ellen shrugged. "Graham told you; we're grading on the side for Gerry Reich."

"Huh." Victor leaned back. "Ever since I've been at UCLA, Reich has had a reputation for being an operator. He's got big government contracts and all this consulting at LotsaTech. He tries to come across as a one-man supergenius, but actually it's just money, um, buying lots and lots of peons. So what do you think he's up to?"

Ellen shrugged. "Technically, I bet Gerry is misusing his contacts with LotsaTech. But I doubt if they care; they really like him." She brightened. "And I approve of what Prof. Reich is doing with this grading project. When I was a TA, I wished there was some way that I could make a day-long project out of reading each student's exam. That was an impossible wish; there was just never enough time. But with his contacts here at LotsaTech, Gerry Reich has come close to doing it. He's paying some pretty sharp grad students very good money to grade and comment on every single essay question. Time is no object, he's telling us. The students in these classes are going to get really great feedback."

"This guy Reich keeps popping up," said Dixie Mae. "He was behind the testing program that selected Victor and me and the others for customer support."

"Well, Victor's right about him. Reich is a manipulator. I know he's been running tests all this week. He grabbed all of Olson Hall for the operation. We didn't know what it was for until afterwards. He nailed Graham and the rest of our gang for this one-day grading job. It looks like he has all sorts of projects."

"Yeah, we took our tests at Olson Hall, too." There had been a small up-front payment, and hints of job prospects. . . . And Dixie Mae had ended up with maybe the best job offer she'd ever had. "But we did that last week."

"It can't be the same place. Olson Hall is a gym."

"Yes, that's what it looked like to me."

"It was used for the NCAA eliminations last week."

Victor reached for his notepad.



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"Whatever. We gotta be going, Mouse."

"Don't 'Mouse' me, Victor! The NCAA elims were the week of 4 June. I did Gerry's questionnaire yesterday, which was Thursday, 14 June."

"I'm sorry, Ellen," said Dixie Mae. "Yesterday was Thursday, but it was the 21st of June."

Victor made a calming gesture. "It's not a big deal."

Ellen frowned, but suddenly she wasn't arguing. She glanced at her watch. "Let's see your notepad, Victor. What date does it say?"

"It says, June . . . huh. It says June 15."

Dixie Mae looked at her own watch. The digits were so precise, and a week wrong: Fri Jun 15 12:31:18 PDT 2012. "Ellen, I looked at my watch before we walked over here. It said June 22nd."

Ellen leaned on the table and took a close look at Victor's notepad. "I'll bet it did. But both your watch and the notepad get their time off the building utilities. Here you're getting set by our local clock—and you're getting the truth."

Now Dixie Mae was getting mad. "Look, Ellen. Whatever the time service says, *I* would not have made up a whole extra week of my life." All those product-familiarization classes.

"No, you wouldn't." Ellen brought her heels back on the edge of her chair. For a long moment, she didn't say anything, just stared through the haze at the city below.

Finally she said: "You know, Victor, you should be pleased."

"Why is that?" suspiciously.

"You may have stumbled into a real, world-class news story. Tell me. During this extra week of life you've enjoyed, how often have you used your phone?"

Dixie Mae said, "Not at all. Mr. Johnson—he's our instructor—said that we're deadzoned till we get through the first week."

Ellen nodded. "So I guess they didn't expect the scam to last more than a week. See, we are not deadzoned here. LotsaTech has a pretty broad embargo on web access, but I made a couple of phone calls this morning."

Victor gave her a sharp look. "So where do you think the extra week came from?"

Ellen hesitated. "I think Gerry Reich has gone beyond where the UCLA human subjects committee would ever let him go. You guys probably spent one night in drugged sleep, being pumped chock full of LotsaTech product trivia."

"Oh! You mean . . . Just-in-Time Training?" Victor tapped away at his notepad. "I thought that was years away."

"It is if you play by the FDA's rules. But there are meds and treatments that can speed up learning. Just read the journals and you'll see that in another year or two, they'll be a scandal as big as sports drugs ever were. I think Gerry has just jumped the gun with something that is very, *very* effective. You have no side-effects. You have all sorts of new, specialized knowledge—even if it's about a throwaway topic. And apparently you have detailed memories of life experience that *never* happened."

Dixie Mae thought back over the last week. There had been no strangeness about her experience at Olson Hall: the exams, the job interview. True, the johns were fantastically clean—like a hospital, now that she thought about it. She had only visited them once, right after she accepted the job offer. And then she had . . . done what? Taken a bus directly out to LotsaTech . . . without even going back to her apartment? After that, everything was clear again. She could remember jokes in the Voxalot classes. She could remember meals, and late night talks with Ulysse about what they might do with this great opportunity. "It's brainwashing," she finally said.

Ellen nodded. "It looks like Gerry has gone way, way too far on this one."

"And he's stupid, too. Our team is going to a party tonight, downtown. All of a sudden, there'll be sixteen people who'll know what's been done to them.



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We'll be mad as—" Dixie Mae noticed Ellen's pitying look.

"Oh." So tonight instead of partying, their customer support team would be in a drugged stupor, *un*remembering the week that never was. "We won't remember a thing, will we?"

Ellen nodded. "My guess is you'll be well-paid, with memories of some one-day temp job here at LotsaTech."

"Well, that's not going to happen," said Victor. "I've got a story and I've got a grudge. I'm not going back."

"We have to warn the others."

Victor shook his head. "Too risky."

Dixie Mae gave him a glare.

Ellen Garcia hugged her knees for a moment. "If this were just you, Victor, I'd be sure you were putting me on." She looked at Dixie Mae for a second. "Let me see that email again."

She spread it out on the table. "LotsaTech has its share of defense and security contracts. I'd hate to think that they might try to shut us up if they knew we were onto them." She whistled an ominous tune. "Paranoia rages. . . . Have you thought that this email might be someone trying to tip you off about what's going on?"

Victor frowned. "Who, Ellen?" When she didn't answer, he said, "So what do you think we should do?"

Ellen didn't look up from the printout. "Mainly, try not to act like idiots. All we really know is that someone has played serious games with your heads. Our first priority is to get us all out of LotsaTech, with you guys free of medical side effects. Our second priority is to blow the whistle on Gerry or . . ." She was reading the mail headers again, ". . . or whoever is behind this."

Dixie Mae said, "I don't think we know enough not to act like idiots."

"Good point. Okay, I'll make a phone call, an innocuous message that should mean something to the police if things go really bad. Then I'll talk to the others in our grading team. We won't say anything while we're still at LotsaTech, but once away from here we'll scream long and loud. You two . . . it might be safest if you just lie low till after dark and we graders get back into town."

Victor was nodding.

Dixie Mae pointed at the mystery email. "What was it you just noticed, Ellen?"

"Just a coincidence, I think. Without a large sample, you start seeing phantoms."

"Speak."

"Well, the mailing address, 'lusting925@freemail.sg'. Building 0925 is on the hill crest thataway."

"You can't see that from where we started."

"Right. It's like 'Lusting' had to get you *here* first. And that's the other thing. Prof. Reich has a senior graduate student named Rob Lusk."

*Lusk? Lusting?* The connection seemed weak to Dixie Mae. "What kind of a guy is he?"

"Rob's not a particularly friendly fellow, but he's about two sigmas smarter than the average grad student. He's the reason Gerry has the big reputation for hardware. Gerry has been using him for five or six years now, and I bet Rob is getting desperate to graduate." She broke off. "Look. I'm going to go inside and tell Graham and the others about this. Then we'll find a place for you to hide for the rest of the day."

She started toward the door.

"I'm not going to hide out," said Dixie Mae.

Ellen hesitated. "Just till closing time. You've seen the rent-a-cops at the main gate. This is not a place you can simply stroll out of. But my group will have no trouble going home this evening. As soon as we're off-site, we'll raise such a stink that the press and police will be back here. You'll be safe at home in no time."

Victor was nodding. "Ellen's right. In fact, it would be even better if we don't spread the story to the other graders. There's no telling—"



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"I'm not going to hide out!" Dixie Mae looked up the hill. "I'm going to check out 0925."

"That's crazy, Dixie Mae! You're guaranteed safe if you just hide till the end of the work day—and then the cops can do better investigating than anything you could manage. You do what Ellen says!"

"No one tells me what to do, Victor!" said Dixie Mae, while inside she was thinking, *Yeah, what I'm doing is a little bit like the plot of a cheap game: teenagers enter haunted house, and then split up to be murdered in pieces . . .*

But Ellen Garcia was making assumptions, too. Dixie Mae glared at both of them. "I'm following up on this email."

Ellen gave her a long look. Whether it was contemptuous or thoughtful wasn't clear. "Just wait for me to tell Graham, okay?"

Twenty minutes later, the three of them were outdoors again, walking up the long grade toward Building 0925.

Graham the Red might be a smart guy, but he turned out to be a fool, too. He was sure that the calendar mystery was just a scam cooked up by Dixie Mae and Victor. Ellen wasn't that good at talking to him—and the two customer support winkies were beneath his contempt. Fortunately, most of the other graders had been willing to listen. One of them also poked an unpleasant hole in all their assumptions: "So if it's that serious, wouldn't Gerry have these two under surveillance? You know, the Conspiracy Gestapo could arrive any second." There'd been a moment of apprehensive silence as everyone waited the arrival of bad guys with clubs.

In the end, everyone including Graham had agreed to keep their mouths shut till after work. Several of them had friends they made cryptic phone calls to, just in case. Dixie Mae could tell that most of them tilted toward Ellen's point of view, but however smart they were, they really didn't want to cross Graham.

Ellen, on the other hand, was *persona non grata* for trying to mess up Graham's schedule. She finally lost her temper with the redheaded jerk.

So now Ellen, Victor, and Dixie Mae were on the yellow brick road—in this case, the asphalt econo-cart walkway—leading to Building 0925.

The LotsaTech campus was new and underpopulated, but there *were* other people around. Just outside of 0999, they ran into a trio of big guys wearing gray blazers like the cops at the main entrance. Victor grabbed Dixie Mae's arm. "Just act natural," he whispered.

They ambled past, Victor giving a gracious nod. The three hardly seemed to notice.

Victor released Dixie Mae's arm. "See? You just have to be cool."

Ellen had been walking ahead. She dropped back so they were three abreast. "Either we're being toyed with," she said, "or they haven't caught on to us."

Dixie Mae touched the email in her pocket. "Well, *somebody* is toying with us."

"You know, that's the biggest clue we have. I still think it could be somebody trying to—"

Ellen fell silent as a couple of management types came walking the other way. These paid them even less attention than the company cops had.

"—it could be somebody trying to help us."

"I guess," said Dixie Mae. "More likely it's some sadist using stuff they learned while I was drugged up."

"Ug. Yeah." They batted around the possibilities. It was strange. Ellen Garcia was as much fun to talk to as Ulysse, even though she had to be about five times smarter than either Ulysse or Dixie Mae.

Now they were close enough to see the lower windows of 0925. This place was a double-sized version of 0999 or 0994. There was a catering truck pulled up at the ground level. Beyond a green-



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tinted windbreak they could see couples playing tennis on the courts south of the building.

Victor squinted. "Strange. They've got some kind of blackout on the windows."

"Yeah. We should at least be able to see the strip lights in the ceiling."

They drifted off the main path and walked around to where they wouldn't be seen from the catering truck. Even up close, down under the overhang, the windows looked just like those on the other buildings. But it wasn't just dark inside. There was nothing but blackness. The inside of the glass was covered with black plastic like they put on closed storefronts.

Victor whipped out his notepad.

"No phone calls, Victor."

"I want to send out a live report, just in case someone gets really mad about us being here."

"I told you, they've got web access embargoed. Besides, just calling from here would trigger 911 locator logic."

"Just a short call, to—"

He looked up and saw that the two women were standing close. "—ah, okay. I'll just use it as a local cam."

Dixie Mae held out her hand. "Give me the notepad, Victor. We'll take the pictures."

For a moment it looked like he was going refuse. Then he saw how her other hand was clenched into a fist. And maybe he remembered the lunchtime stories she had told during the week. *The week that never was?* Whatever the reason, he handed the notepad over to her. "You think I'm working for the bad guys?" he said.

"No," Dixie Mae said (65 percent truthfully, but declining), "I just don't think you'll always do what Ellen suggests. This way we'll get the pictures, but safely." *Because of my superior self control. Yeah.*

She started to hand the notepad to Ellen, but the other shook her head. "Just keep a record, Dixie Mae. You'll get it back later, Victor."

"Oh. Okay, but I want first xmit rights." He brightened. "You'll be my cameragirl, Dixie. Just come back on me anytime I have something important to say."

"Will do, Victor." She panned the notepad camera in a long sweep, away from him.

No one bothered them as they walked halfway around the ground floor. The blackout job was very thorough, but just as at buildings 0994 and 0999, there was an ordinary door with an old-fashioned card swipe.

Ellen took a closer look. "We disabled the locks on 0999 just for the fun of it. Somehow I don't think these black-plastic guys are that easygoing."

"I guess this is as far as we go," said Victor.

Dixie Mae stepped close to the door and gave it push. There was no error beep, no alarms. The door just swung open.

Looks of amazement were exchanged.

Five seconds later they were still standing at the open doorway. What little they could see looked like your typical LotsaTech ground floor. "We should shut the door and go back," said Victor. "We'll be caught red-handed standing here."

"Good point." Ellen stepped inside, followed perforce by Victor, and then Dixie Mae taking local video.

"Wait! Keep the door open, Dixie Mae."

"Jeez."

"This is like an airlock!" They were in a tiny room. Above waist height, its walls were clear glass. There was another door on the far end of the little room.

Ellen walked forward. "I had a summer job at Livermore last year. They have catch boxes like this. You walk inside easy enough—and then there are armed guards all around, politely asking you if you're lost." There were no guards visible here. Ellen pressed on the inner door. Locked. She reached up to the



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latch mechanism. It looked like cheap plastic. "This should not work," she said, even as she fiddled at it.

They could hear voices, but from upstairs. Down here, there was no one to be seen. Some of the layout was familiar, though. If this had been Building 0994, the hallway on the right would lead to restrooms, a small cafeteria, and a temporary dormitory.

Ellen hesitated and stood listening. She looked back at them. "That's strange. That sounds like . . . Graham!"

"Can you just break the latch, Ellen?" *We should go upstairs and strangle the two-faced weasel with his own ponytail.*

Another sound. A door opening! Dixie Mae looked past Ellen and saw a guy coming out of the men's room. Dixie Mae managed to grab Victor, and the two of them dropped behind the lower section of the holding cell.

"Hey, Ellen," said the stranger, "you look a bit peaked. Is Graham getting on your nerves, too?"

Ellen gave a squeaky laugh. "Y-yeah . . . so what else is new?"

Dixie Mae twisted the notepad and held it so the camera eye looked through the glass. In the tiny screen, she could see that the stranger was smiling. He was dressed in tee-shirt and knee-pants and he had some kind of glittering badge on a loop around his neck.

Ellen's mouth opened and shut a couple of times, but nothing came out. *She doesn't know this guy from Adam.*

The stranger was still clueless, but—"Hey, where's your badge?"

"Oh . . . damn. I must have left in the john," said Ellen. "And now I've locked myself out."

"You know the rules," he said, but his tone was not threatening. He did something on his side of the door. It opened and Ellen stepped through, blocking the guy's view of what was behind her.

"I'm sorry. I, uh, I got flustered."

"That's okay. Graham will eventually shut up. I just wish he'd pay more attention to what the professionals are asking of him."

Ellen nodded. "Yeah, I hear you!" Like she was really, really agreeing with him.

"Y'see, Graham's not splitting the topics properly. The idea is to be both broad *and* deep."

Ellen continued to make understanding noises. The talkative stranger was full of details about some sort of a NSA project, but he was totally ignorant of the three intruders.

There were light footsteps on the stairs, and a familiar voice. "Michael, how long are you going to be? I want to—" The voice cut off in a surprised squeak.

On the notepad display, Dixie Mae could see two brown-haired girls staring at each other with identical expressions of amazement. They sidled around each other for a moment, exchanging light slaps. It wasn't fighting . . . it was as if each thought the other was some kind of trick video. *Ellen Garcia, meet Ellen Garcia.*

The stranger—Michael?—stared with equal astonishment, first at one Ellen and then the other. The Ellens made inarticulate noises just loud enough to interrupt each other and make them even more upset.

Finally Michael said, "I take it you don't have a twin sister, Ellen?"

"No!" said both.

"So one of you is an impostor. But you've spun around so often now that I can't tell who is the original. Ha." He pointed at one of the Ellens. "Another good reason for having security badges."

But Ellen and Ellen were ignoring everyone except themselves. Except for their chorus of "No!", their words were just mutual interruptions, unintelligible. Finally, they hesitated and gave each other a nasty smile. Each reached into her pocket. One came out with a dollar coin, and the other came out empty.

"Ha! I've got the token. Deadlock broken." The other grinned and nodded. Dollar-coin Ellen turned to Michael. "Look, we're both real. And we're both


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only-children."

Michael looked from one to the other. "You're certainly not clones, either."

"Obviously," said the token holder. She looked at the other Ellen and asked, "Fridge-rot?"

The other nodded and said, "In April I made that worse." And both of them laughed.

Token holder: "Gerry's exam in Olson Hall?"

"Yup."

Token holder: "Michael?"

"After that," the other replied, and then she blushed. After a second the token holder blushed, too.

Michael said dryly, "And you're not perfectly identical."

Token holder Ellen gave him a crooked smile. "True. I've never seen you before in my life." She turned and tossed the dollar coin to the other Ellen, left hand to left hand.

And now that Ellen had the floor. She was also the version wearing a security badge. Call her NSA Ellen. "As far as I—we—can tell, we had the same stream of consciousness up through the day we took Gerry Reich's recruitment exam. Since then, we've had our own lives. We've even got our own new friends." She was looking in the direction of Dixie Mae's camera.

Grader Ellen turned to follow her gaze. "Come on out, guys. We can see your camera lens."

Victor and Dixie Mae stood and walked out of the security cell.

"A right invasion you are," said Michael, and he did not seem to be joking.

NSA Ellen put her hand on his arm. "Michael, I don't think we're in Kansas anymore."

"Indeed! I'm simply dreaming."

"Probably. But if not—" she exchanged glances with grader Ellen "—maybe we should find out what's been done to us. Is the meeting room clear?"

"Last I looked. Yes, we're not likely to be bothered in there." He led them down a hallway toward what was simply a janitor's closet back in Building 0994.

Michael Lee and NSA Ellen were working on still another of Professor Reich's projects. "Y'see," said Michael, "Professor Reich has a contract with my colleagues to compare our surveillance software with what intense human analysis might accomplish."

"Yes," said NSA Ellen, "the big problem with surveillance has always been the enormous amount of stuff there is to look at. The spook agencies use lots of automation and have lots of great specialists—people like Michael here—but they're just overwhelmed. Anyway, Gerry had the idea that even though that problem can't be solved, maybe a team of spooks and graduate students could at least estimate how much the NSA programs are missing."

Michael Lee nodded. "We're spending the entire summer looking at 1300 to 1400UTC 10 June 2012, backwards and forwards and up and down, but on just three narrow topic areas."

Grader Ellen interrupted him. "And this is your first day on the job, right?"

"Oh, no. We've been at this for almost a month now." He gave a little smile. "My whole career has been the study of contemporary China. Yet this is the first assignment where I've had enough time to look at the data I'm supposed to pontificate upon. It would be a real pleasure if we didn't have to enforce security on these rambunctious graduate students."

NSA Ellen patted him on the shoulder. "But if it weren't for Michael here, I'd be as frazzled as poor Graham. One month down and two months to go."

"You think it's *August*?" said Dixie Mae.

"Yes, indeed." He glanced at his watch. "The 10 August it is."

Grader Ellen smiled and told him the various dates the rest of them thought today was.

"It's some kind of drug hallucination thing," said Victor. "Before we thought it was just Gerry Reich's doing. Now I



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think it's the government torquing our brains."

Both Ellens look at him; you could tell they both knew Victor from way back. But they seemed to take what he was saying seriously. "Could be," they both said.

"Sorry," grader Ellen said to NSA Ellen. "You've got the dollar."

"You could be right, Victor. But cognition is my—our—specialty. We two are something way beyond normal dreaming or hallucinations."

"Except *that* could be illusion, too," said Victor.

"Stuff it, Victor," said Dixie Mae. "If it's *all* a dream, we might as well give up." She looked at Michael Lee. "What is the government up to?"

Michael shrugged. "The details are classified, but it's just a post hoc survey. The isolation rules seem to be something that Professor Reich has worked out with my agency."

NSA Ellen flicked a glance at her double. The two had a brief and strange conversation, mostly half-completed words and phrases. Then NSA Ellen continued, "Mr. Renaissance Man Gerry Reich seems to be at the center of everything. He used some standard personality tests to pick out articulate, motivated people for the customer support job. I bet they do a very good job on their first day."

*Yeah.* Dixie Mae thought of Ulysse. And of herself.

NSA Ellen continued, "Gerry filtered out another group—graduate students in just the specialty for grading all his various exams and projects."

"We only worked on one exam," said grader Ellen. But she wasn't objecting. There was an odd smile on her face, the look of someone who has cleverly figured out some very bad news.

"And then he got a bunch of government spooks and CS grads for this surveillance project that Michael and I are on."

Michael looked mystified. Victor looked vaguely sullen, his own theories lying trampled somewhere in the dust.

"But," said Dixie Mae, "your surveillance group has been going for a month you say . . ."

Victor: "And the graders *do* have phone contact with the outside!"

"I've been thinking about that," said grader Ellen. "I made three phone calls today. The third was after you and Dixie Mae showed up. That was voicemail to a friend of mine at MIT. I was cryptic, but I tried to say enough that my friend would raise hell if I disappeared. The others calls were—"

"Voicemail, too?" asked NSA Ellen.

"One was voicemail. The other call was to Bill Richardson. We had a nice chat about the party he's having Saturday. But Bill—"

"Bill took Reich's 'job test' along with the rest of us!"

"Right."

Where this was heading was worse than Victor's dream theory. "S-so what has been done to us?" said Dixie Mae.

Michael's eyes were wide, though he managed a tone of dry understatement: "Pardon a backward Han language specialist. You're thinking we're just personality uploads? I thought that was science fiction."

Both Ellens laughed. One said, "Oh, it *is* science fiction, and not just the latest *Kywrack* episode. The genre goes back almost a century."

The other: "There's Sturgeon's 'Microcosmic God'."

The first: "That would be rich; Gerry beware then! But there's also Pohl's 'Tunnel Under the World'."

"Cripes. We're toast if that's the scenario."

"Okay, but how about Varley's 'Overdrawn at the Memory Bank'?"

"How about Wilson's *Darwinia*?"

"Or Moravec's 'Pigs in Cyberspace'?"

"Or Galouye's *Simulacron-3*?"

"Or Vinge's deathcubes?"

Now that the 'twins' were not in perfect synch, their words were a building, rapid-fire chorus, climaxing with:

"Brin's 'Stones of Significance'!"



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"Or *Kiln People*!"

"No, it couldn't be that." Abruptly they stopped, and nodded at each other. A little bit grimly, Dixie Mae thought. In all, the conversation was just as inscrutable as their earlier self-interrupted spasms.

Fortunately, Victor was there to rescue pedestrian minds. "It doesn't matter. The fact is, uploading is *only* sci-fi. It's worse that faster-than-light travel. There's not even a theoretical basis for uploads."

Each Ellen raised her left hand and made a faffling gesture. "Not exactly, Victor."

The token holder continued, "I'd say there is a *theoretical* basis for saying that uploads are theoretically possible." They gave a lopsided smile. "And guess who is responsible for that? Gerry Reich. Back in 2005, way before he was famous as a multi-threat genius, he had a couple of papers about upload mechanisms. The theory was borderline kookiness and even the simplest demo would take far more processing power than any supercomputer of the time."

"Just for a one-personality upload."

"So Gerry and his Reich Method were something of a laughingstock."

"After that, Gerry dropped the idea—just what you'd expect, considering the showman he is. But now he's suddenly world-famous, successful in half a dozen different fields. I think something happened. *Somebody* solved his hardware problem for him."

Dixie Mae stared at her email. "Rob Lusk," she said, quietly.

"Yup," said grader Ellen. She explained about the mail.

Michael was unconvinced. "I don't know, E-Ellen. Granted, we have an extraordinary miracle here—" gesturing at both of them, "—but speculating about cause seems to me a bit like a sparrow understanding the 405 Freeway."

"No," said Dixie Mae, and they all looked back her way. She felt so frightened and so angry—but of the two, angry was better: "Somebody has *set us up!* It started in those superclean restrooms in Olson Hall—"

"Olson Hall," said Michael. "You were there too? The lavs smelled like a hospital! I remember thinking that just as I went in, but—hey, the next thing I remember is being on the bus, coming up here."

*Like a hospital.* Dixie Mae felt rising panic. "M-maybe we're all that's left." She looked at the twins. "This uploading thing, does it kill the originals?"

It was kind of a showstopper question; for a moment everyone was silent. Then the token holder said, "I—don't think so, but Gerry's papers were mostly theoretical."

Dixie Mae beat down the panic; rage did have its uses. *What can we know from here on the inside?* "So far we know more than thirty of us who took the Olson Hall exams and ended up here. If we were all murdered, that'd be hard to cover up. Let's suppose we still have a life." Inspiration: "And maybe there are things we can figure! We have three of Reich's experiments to compare. There are differences, and they tell us things." She looked at the twins. "You've already figured this out, haven't you? The Ellen we met first is grading papers—just a one-day job, she's told. But I'll bet that every night, when they think they're going home—Lusk or Reich or whoever is doing this just turns them off, and *cycles them back* to do some other 'one-day' job."

"Same with our customer support," said Victor, a grudging agreement.

"Almost. We had six days of product familiarization, and then our first day on the job. We were all so enthusiastic. You're right, Ellen, on our first day we are great!" *Poor Ulysse, poor me; we thought we were going somewhere with our lives.* "I'll bet we disappear tonight, too."

Grader Ellen was nodding. "Customer-support-in-a-box, restarted and restarted, so it's always fresh."



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"But there are still problems," said the other one. "Eventually, the lag in dates would tip you off."

"Maybe, or maybe the mail headers are automatically forged."

"But internal context could contradict—"

"Or maybe Gerry has solved the cognitive haze problem—" The two were off into their semi-private language.

Michael interrupted them. "Not everybody is recycled. The point of our net-tracking project is that we spend the entire summer studying just one hour of network traffic."

The twins smiled. "So you think," said the token holder. "Yes, in this building we're not rebooted after every imaginary day. Instead, they run us the whole 'summer'—minutes of computer time instead of seconds?—to analyze one hour of network traffic. And then they run us again, on a different hour. And so on and on."

Michael said, "I can't imagine technology that powerful."

The token holder said, "Neither can I really, but—"

Victor interrupted with, "Maybe this is the *Darwinia* scenario. You know: we're just the toys of some superadvanced intelligence."

"No!" said Dixie Mae. "Not superadvanced. Customer support and net surveillance are valuable things in our own real world. Whoever's doing this is just getting slave labor, run really, really fast."

Grader Ellen glowered. "And grading his exams for him! That's the sort of thing that shows me it's really Gerry behind this. He's making chumps of all of us, and rerunning us before we catch on or get seriously bored."

NSA Ellen had the same expression, but a different complaint: "We *have* been seriously bored here."

Michael nodded. "Those from the government side are a patient lot; we've kept the graduate students in line. We can last three months. But it does . . . rankle . . . to learn that the reward for our patience is that we get to do it all over again. Damn. I'm sorry, Ellen."

"But now we know!" said Dixie Mae.

"And what good does it do you?" Victor laughed. "So you guessed this time. But at the end of the microsecond day, poof, it's reboot time and everything you've learned is gone."

"Not *this* time." Dixie Mae looked away from him, down at her email. The cheap paper was crumpled and stained. A digital fake, *but so are we*. "I don't think we're the only people who've figured things out." She slid the printout across the table, toward grader Ellen. "You thought it meant Rob Lusk was in this building."

"Yeah, I did."

"Who's Rob Lusk?" said Michael.

"A weirdo," NSA Ellen said absently. "Gerry's best grad student." Both Ellens were staring at the email.

"The 0999 reference led Dixie Mae to my grading team. Then I pointed out the source address."

"lusting925@freemail.sg?"

"Yes. And that got us here."

"But there's no Rob Lusk here," said NSA Ellen. "Huh! I like these fake mail headers."

"Yeah. They're longer than the whole message body!"

Michael had stood to look over the Ellens' shoulders. Now he reached between them to tap the message. "See there, in the middle of the second header? That looks like Pinyin with the tone marks written in-line."

"So what does it *say?*"

"Well, if it's Mandarin, it would be the number 'nine hundred and seventeen'."

Victor was leaning forward on his elbows. "That has to be coincidence. How could Lusting know just who we'd encounter?"

"Anybody know of a Building 0917?" said Dixie Mae.

"I don't," said Michael. "We don't go out of our building except to the pool and tennis courts."

The twins shook their heads. "I


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haven't seen it . . . and right now I don't want to risk an intranet query."

Dixie Mae thought back to the Lotsa-Tech map that had been in the welcome-aboard brochures. "If there is such a place, it would be farther up the hill, maybe right at the top. I say we go up there."

"But—" said Victor.

"Don't give me that garbage about waiting for the police, Victor, or about not being idiots. This *isn't* Kansas anymore, and this email is the only clue we have."

"What should we tell the people here?" said Michael.

"Don't tell them anything! We just sneak off. We want the operation here to go on normally, so Gerry or whoever doesn't suspect."

The two Ellens looked at each other, a strange, sad expression on their faces. Suddenly they both started singing "Home on the Range," but with weird lyrics:

*"Oh, give me a clone*
*Of my own flesh and bone*
*With—"*

They paused and simultaneously blushed. "What a dirty mind that man Garrett had."

"Dirty but deep." NSA Ellen turned to Michael, and she seemed to blush even more. "Never mind, Michael. I think . . . you and I should stay here.

"No, wait," said Dixie Mae. "Where we're going we may have to convince someone that this crazy story is true. You Ellens are the best evidence we have."

The argument went round and round. At one point, Dixie Mae noticed with wonder that the two Ellens actually seemed to be arguing against each other.

"We don't know enough to decide," Victor kept whining.

"We have to do something, Victor. We *know* what happens to you and me if we sit things out till closing time this afternoon."

In the end Michael did stay behind. He was more likely to be believed by his government teammates. If the Ellens and Dixie Mae and Victor could bring back some real information, maybe the NSA group could do some good.

"We'll be a network of people trying to break this wheel of time." Michael was trying to sound wryly amused, but once he said the words he was silent, and none of the others could think of anything better to say.

Up near the hilltop, there were not nearly as many buildings, and the ones that Dixie Mae saw were single story, as though they were just entrances to something *under* the hills. The trees were stunted and the grass yellower.

Victor had an explanation. "It's the wind. You see this in lots of exposed land near the coast. Or maybe they just don't water very much up here."

An Ellen—from behind, Dixie Mae couldn't tell which one—said, "Either way, the fabrication is awesome."

*Right. A fabrication.* "That's something I don't understand," said Dixie Mae. "The best movie fx don't come close to this. How can their computers be this good?"

"Well for one thing," said the other Ellen, "cheating is a lot easier when you're also simulating the observers."

"Us."

"Yup. Everywhere you look, you see detail, but it's always at the center of your focus. We humans don't keep everything we've seen and everything we know all in mind at the same time. We have millions of years of evolution invested in ignoring almost everything, and conjuring sense out of nonsense."

Dixie Mae looked southward into the haze. It was all so real: the dry hot breeze, the glint of aircraft sliding down the sky toward LAX, the bulk of the Empire State Building looming up from the skyscrapers at the center of downtown.

"There are probably dozens of omis-



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sions and contradictions around us every second, but unless they're brought together in our attention all at once we don't notice them."

"Like the time discrepancy," said Dixie Mae.

"Right! In fact, the biggest problem with all our theories is not how we could be individually duped, but how the fraud could work with many communicating individuals all at once. That takes hardware beyond anything that exists, maybe a hundred liters of Bose condensate."

"Some kind of quantum computer breakthrough," said Victor.

Both Ellens turned to look at him, eyebrows raised.

"Hey, I'm a journalist. I read it in the *Bruin* science section."

The twins' reply was something more than a monologue and less than a conversation:

"Well . . . even so, you have a point. In fact, there were rumors this spring that Gerry had managed to scale Gershenfeld's coffee cup coherence scheme."

"Yeah, how he had five hundred liters of Bose condensate at room temperature."

"But those stories started way after he had already become Mr. Renaissance Man. It doesn't make sense."

*We're not the first people hijacked.*

"Maybe," said Dixie Mae, "maybe he started out with something simple, like a single superspeed human. Could Gerry run a single upload with the kind of supercomputers we have nowadays?"

"Well, that's more conceivable than this . . . *oh*. Okay, so an isolated genius was used to do a century or so of genius work on quantum computing. That sounds like the deathcube scenario. If it were me, after a hundred years of being screwed like that, I'd give Gerry one hell of a surprise."

"Yeah, like instead of a cure for cancer, he'd get airborne rabies targeted on the proteome of scumbag middle-aged male CS profs."

The twins sounded as bloody-minded as Dixie Mae.

They walked another couple of hundred yards. The lawn degenerated into islands of crabgrass in bare dirt. The breeze was a hot whistling along the ridgeline. The twins stopped every few paces to look closely, now at the vegetation, now at a guide sign along the walkway. They were mumbling at each other about the details of what they were seeing, as if they were trying to detect inconsistencies:

". . . really, really good. We agree on everything we see."

"Maybe Gerry is saving cycles, running us as cognitive subthreads off the same process."

"Ha! No wonder we're still so much in synch."

*Mumble, mumble.* "There's really a lot we can infer—"

"—once we accept the insane premise of all this."

There was still no "Building 0917," but what buildings they did see had lower and lower numbers: 0933, 0921. . . .

A loud group of people crossed their path just ahead. They were singing. They looked like programmers.

"Just be cool," an Ellen said softly. "That conga line is straight out of the LotsaTech employee motivation program. The programmers have onsite parties when they reach project milestones."

"More victims?" said Victor. "Or AIs?"

"They might be victims. But I'll bet all the people we've seen along this path are just low-level scenery. There's nothing in Reich's theories that would make true AIs possible."

Dixie Mae watched the singers as they drifted down the hillside. This was the third time they had seen something-like-people on the walkway. "It doesn't make sense, Ellen. We think we're just—"

"Simulation processes."

"Yeah, simulation processes, inside some sort of super super-computer. But



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if that's true, then whoever is behind this should be able to spy on us better than any Big Brother ever could in the real world. We should've been caught and rebooted the minute we began to get suspicious."

Both Ellens started to answer. They stopped, then interrupted each other again.

"Back to who's-got-the-token," one said, holding up the dollar coin. "Dixie Mae, that is a mystery, but not as big as it seems. If Reich is using the sort of upload and simulation techniques I know about, then what goes on inside our minds can't be interpreted directly. Thoughts are just too idiosyncratic, too scattered. If we are simulations in a large quantum computer, even environment probes would be hard to run."

"You mean things like spy cameras?"

"Yes. They would be hard to implement, since in fact they would be snooping on the state of our internal imagery. All this is complicated by the fact that we're probably running thousands of times faster than real time. There are maybe three ways that Gerry could snoop: he could just watch team output, and if it falls off, he'd know that something had gone wrong—and he might reboot on general principles."

Suddenly Dixie Mae was very glad that they hadn't taken more volunteers on this hike.

"The second snoop method is just to look at things we write or the output of software we explicitly run. I'll bet that anything that we perceive as linear text *is* capable of outside interpretation." She looked at Victor. "That's why no note-taking." Dixie Mae still had his notepad.

"It's kinda stupid," said Victor. "First it was no pictures and now not even notes.

"Hey, look!" said the Ellens. "B0917!" But it wasn't a building, just a small sign wedged among the rocks.

They scrambled off the asphalt onto a dirt path that led directly up the hillside.

Now they were so near the hill crest that the horizon was just a few yards away. Dixie Mae couldn't see any land beyond. She remembered a movie where poor slobs like themselves got to the edge of the simulation . . . and found the wall at the end of their universe. But they took a few more steps and she could see over the top. There was a vista of further, lower hills, dropping down into the San Fernando Valley. Not quite hidden in the haze she could see the familiar snakey line of Highway 101: Tarzana.

Ellen and Ellen and Victor were not taking in the view. They were staring at the sign at the side of the path. Fifteen feet beyond that was a construction dig. There were building supplies piled neatly along the edge of the cut, and a robo-Cat parked on the far side. It might have been the beginning of the construction of a standard-model LotsaTech building . . . except that in the far side of the pit, almost hidden in shadows, there was a circular metal plug, like a bank vault door in some old movie.

"I have this theory," said the token holder. "If we get through that door, we may find out what your email is all about."

"Yup." The twins bounced down a steeply cut treadway into the pit. Dixie Mae and Victor scrambled after them, Victor clumsily bumping into her on the way down. The bottom of the pit was like nothing before. There were no windows, no card swipe. And up close, Dixie Mae could see that the vault door was pitted and scratched.

"They're mixing metaphors," said the token holder. "This entrance looks older than the pit."

"It looks old as the hills," Dixie Mae said, running her hand over the uneven metal—and half expecting to feel weirdo runes. "Somebody is trying to give us clues . . . or somebody is a big sadist. So what do we do? Knock a magic knock?"

"Why not?" The two Ellens took her tattered email and laid it out flat on the



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metal of the door. They studied the mail headers for a minute, mumbling to each other. The token holder tapped on the metal, then pushed.

"Together," they said, and tapped out a random something, but perfectly in synch.

That had all the effect you'd expect of tapping your fingers on ten tons of dead steel.

The token holder handed the email back to Dixie Mae. "You try something."

*But what?* Dixie Mae stepped to the door. She stood there, feeling clueless. Off to the side, almost hidden by the curve of the metal plug, Victor had turned away.

He had the notepad.

"Hey!" She slammed him into the side of the pit. Victor pushed her away, but by then the Ellens were on him. There was a mad scramble as the twins tried to do all the same things to Victor. Maybe that confused him. Anyway, it gave Dixie Mae a chance to come back and punch him in the face.

"I got it!" One of the twins jumped back from the fighting. She had the notepad in her hands.

They stepped away from Victor. He wasn't going to get his notepad back. "So, Ellen," said Dixie Mae, not taking her eyes off the sprawled figure, "what was that third method for snooping on us?"

"I think you've already guessed. Gerry could fool some idiot into uploading as a spy." She was looking over her twin's shoulder at the notepad screen.

Victor picked himself up. For a moment he looked sullen, and then the old superior smile percolated across his features. "You're crazy. I just want to break this story back in the real world. Don't you think that if Reich were using spies, he'd just upload himself?"

"That depends."

The one holding the notepad read aloud: "You just typed in: '925 999 994 know. reboot'. That doesn't sound like journalism to me, Victor."

"Hey, I was being dramatic." He thought for a second, and then laughed. "It doesn't matter anymore! I got the warning out. You won't remember any of this after you're rebooted."

Dixie Mae stepped toward him. "And you won't remember that I broke your neck."

Victor tried to look suave and jump backwards at the same time. "In fact, I *will* remember, Dixie Mae. See, once you're gone, I'll be merged back into my body in Doc Reich's lab."

"And we'll be dead again!"

Ellen held up the notepad. "Maybe not as soon as Victor thinks. I notice he never got past the first line of his message; he never pressed return. Now, depending on how faithfully this old notepad's hardware is being emulated, his treason is still trapped in a local cache—and Reich is still clueless about us."

For a moment, Victor looked worried. Then he shrugged. "So you get to live the rest of this run, maybe corrupt some other projects—ones a lot more important than you. On the other hand, I did learn about the email. When I get back and tell Doc Reich, he'll know what to do. You won't be going rogue in the future."

Everyone was silent for a second. The wind whistled across the yellow-blue sky above the pit.

And then the twins gave Victor the sort of smile he had bestowed on them so often. The token holder said, "I think your mouth is smarter than you are, Victor. You asked the right question a second ago: Why doesn't Gerry Reich upload himself to be the spy? Why does he have to use you?"

"Well," Victor frowned. "Hey, Doc Reich is an important man. He doesn't have time to waste with security work like this."

"Really, Victor? He can't spare even a copy of himself?"

Dixie Mae got the point. She closed in on Victor. "So how many times have *you* been merged back into your original?"

"This is my first time here!" Everybody but Victor laughed, and he rushed


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on, "But I've *seen* the merge done!"

"Then why won't Reich do it for *us*?"

"Merging is too expensive to waste on work threads like you," but now Victor was not even convincing himself.

The Ellens laughed again. "Are you really a UCLA journalism grad, Victor? I thought they were smarter than this. So Gerry showed you a re-merge, did he? I bet that what you actually saw was a lot of equipment and someone going through very dramatic convulsions. And then the 'subject' told you a nice story about all the things he'd seen in our little upload world. And all the time they were laughing at you behind their hands. See, Reich's upload theory depends on having a completely regular target. I know that theory: the merge problem—loading onto an existing mind—is exponential in the neuron count. There's no way back, Victor."

Victor was backing away from them. His expression flickered between superior sneer and stark panic. "What you think doesn't matter. You're just going to be rebooted at 5 P.M. And you don't know everything." He began fiddling with the fly zipper on his pants. "You see, I—*I* can escape!"

"*Get him!*"

Dixie Mae was closest. It didn't matter.

There was no hazy glow, no sudden popping noise. She simply fell through thin air, right where Victor had been standing.

She picked herself up and stared at the ground. Some smudged footprints were the only sign Victor had been there. She turned back to the twins. "So he could re-merge after all?"

"Not likely," said the token holder. "Victor's zipper was probably a thread self-terminate mechanism."

"His *pants zipper?*"

They shrugged. "I dunno. To leak out? Gerry has a perverse sense of humor." But neither twin looked amused. They circled the spot where Victor had left and kicked unhappily at the dirt. The token holder said, "Cripes. Nothing in Victor's life became him like the leaving it. I don't think we have even till '5 P.M.' now. A thread terminate signal is just the sort of thing that would be easy to detect from the outside. So Gerry won't know the details, but he—"

"—or his equipment—"

"—will soon know there is a problem and—"

"—that it's probably a security problem."

"So how long do we have before we lose the day?" said Dixie Mae.

"If an emergency reboot has to be done manually, we'll probably hit 5 P.M. first. If it's automatic, well, I know you won't feel insulted if the world ends in the middle of a syllable."

"Whatever it is, I'm going to use the time." Dixie Mae picked her email up from where it lay by the vault entrance. She waved the paper at the impassive steel. "I'm not going back! I'm here and I want some explanations!"

Nothing.

The two Ellens stood there, out of ideas and looking unhappy—or maybe that amounted to the same thing.

"I'm not giving up," Dixie Mae said to them, and pounded on the metal.

"No, I don't think you are," said the token holder. But now they were looking at her strangely. "I think we—*you* at least—must have been through this before."

"Yeah. And I must have messed up every time."

"No . . . I don't think so." They pointed at the email that she held crumpled in her hand. "Where do you think all those nasty secrets come from, Dixie Mae?"

"How the freakin' heck do I know? That's the whole reason I—" and then she felt smart and stupid at the same time. She leaned her head against the shadowed metal. "Oh. Oh oh *oh!*"

She looked down at the email hardcopy. The bottom part was torn, smeared, almost illegible. No matter; *that* part she had memorized. The Ellens had gone over the headers one by one. *But now we shouldn't be looking for*


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*technical secrets or grad student inside jokes. Maybe we should be looking for numbers that mean something to Dixie Mae Leigh.*

"If there were uploaded souls guarding the door, what you two have already done ought to be enough. I think you're right. It's some pattern I'm supposed to tap on the door." If it didn't work, she'd try something else, and keep trying till 5 P.M. or whenever she was suddenly back in Building 0994, so happy to have a job with potential. . . .

*The tree house in Tarzana.* Dixie Mae had been into secret codes then. Her childish idea of crypto. She and her little friends used a tap code for sending numbers. It hadn't lasted long, because Dixie Mae was the only one with the patience to use it. But—

"That number, '7474'," she said.

"Yeah? Right in the middle of the fake message number?"

"Yes. Once upon a time, I used that as a password challenge. You know, like 'Who goes there' in combat games. The rest of the string could be the response."

The Ellens looked at each. "Looks too short to be significant," they said.

Then they both shook their heads, disagreeing with themselves. "Try it, Dixie Mae."

Her "numbers to taps" scheme had been simple, but for a moment she couldn't remember it. She held the paper against the vault and glared at the numbers. *Ah.* Carefully, carefully, she began tapping out the digits that came after "7474." The string was much longer than anything her childhood friends would have put up with. It was longer than anything she herself would have used.

"Cool," said the token holder. "Some kind of hex gray code?"

*Huh?* "What do you expect, Ellen? I was only eight years old."

They watched the door.

Nothing.

"Okay, on to Plan B," *and then to C and D and E, etc, until our time ends.*

There was the sound of something very old breaking apart. The vault door shifted under Dixie Mae's hand and she jumped back. The curved plug slowly turned, and turned, and turned. After some seconds, the metal plug thudded to the ground beside the entrance . . . and they were looking down an empty corridor that stretched off into the depths.

For the first quarter mile, no one was home. The interior decor was *not* LotsaTech standard. Gone were the warm redwood veneers and glow strips. Here fluorescent tube lights were mounted in the acoustic tile ceiling, and the walls were institutional beige.

"This reminds me of the basement labs in Norman Hall," said one Ellen.

"But there are *people* in Norman Hall," said the other. They were both whispering.

And here there were stairways that led only down. And down and down.

Dixie Mae said, "Do you get the feeling that whoever is here is in for the long haul?"

"Huh?"

"Well, the graders in B0999 were in for a day, and they thought they had real phone access to the outside. My group in Customer Support had six days of classes and then probably just one more day, where we answered queries—and we had no other contact with the outside."

"Yes," said NSA Ellen. "My group had been running for a month, and we were probably not going to expire for another two. We were officially isolated. No phones, no email, no weekends off. The longer the cycle time, the more isolation. Otherwise, the poor suckers would figure things out."

Dixie Mae thought for a second. "Victor really didn't want us to get this far. Maybe—" *Maybe, somehow, we can make a difference.*

They passed a cross corridor, then a second one. A half-opened door showed them an apparent dormitory room. Fresh bedding sat neatly folded on a mat-


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tress. Somebody was just moving in?

Ahead there was another doorway, and from it they could hear voices, argument. They crept along, not even whispering.

The voices were making words: "—is a year enough time, Rob?"

The other speaker sounded angry. "Well, it's got to be. After that, Gerry is out of money and I'm out of time."

The Ellens waved Dixie Mae back as she started for the door. Maybe they wanted to eavesdrop for a while. *But how long do we have before time ends?* Dixie Mae brushed past them and walked into the room.

There were two guys there, one sitting by an ordinary data display.

"Jesus! Who are you?"

"Dixie Mae Leigh." *As you must certainly know.*

The one sitting by the terminal gave her a broad grin, "Rob, I thought we were isolated?"

"That's what Gerry said." This one—Rob Lusk?—looked to be in his late twenties. He was tall and thin and had kind of a desperate look to him. "Okay, Miss Leigh. What are you here for?"

"That's what you're going to tell me, Rob." Dixie Mae pulled the email from her pocket and waived the tattered scrap of paper in his face. "I want some explanations!"

Rob's expression clouded over, a no-one-tells-me-what-to-do look.

Dixie Mae glared back at him. Rob Lusk was a mite too big to punch out, but she was heating up to it.

The twins chose that moment to make their entrance. "Hi there," one of them said cheerily.

Lusk's eyes flickered from one to the other and then to the NSA ID badge. "Hello. I've seen you around the department. You're Ellen, um, Gomez?"

"Garcia," corrected NSA Ellen. "Yup. That's me." She patted grader Ellen on the shoulder. "This is my sister, Sonya." She glanced at Dixie Mae. *Play along,* her eyes seemed to say. "Gerry sent us."

"He did?" The fellow by the computer display was grinning even more. "See, I told you, Rob. Gerry can be brutal, but he'd never leave us without assistants for a whole year. Welcome, girls!"

"Shut up, Danny." Rob looked at them hopefully, but unlike Danny-boy, he seemed quite serious. "Gerry told you this will be a year-long project?"

The three of them nodded.

"We've got plenty of bunk rooms, and separate . . . um, facilities." He sounded . . . Lord, he sounded embarrassed. "What are your specialties?"

The token holder said, "Sonya and I are second-year grads, working on cognitive patterning."

Some of the hope drained from Rob's expression. "I know that's Gerry's big thing, but we're mostly doing hardware here." He looked at Dixie Mae.

"I'm into—" *go for it* "—Bose condensates." Well, she knew how to pronounce the words.

There were worried looks from the Ellens. But one of them piped up with, "She's on Satya's team at Georgia Tech."

It was wonderful what the smile did to Rob's face. His angry expression of a minute before was transformed into the look of a happy little boy on his way to Disneyland. "Really? I can't tell you what this means to us! I knew it had to be someone like Satya behind the new formulations. Were you in on that?"

"Oh, yeah. Some of it, anyway." Dixie Mae figured that she couldn't say more than twenty words without blowing it. But what the heck—how many more minutes did the masquerade have to last, anyway? Little Victor and his self-terminating thread . . .

"That's great. We don't have budget for real equipment here, just simulators—"

Out of the corner of her eye, she saw the Ellens exchange a *fer sure* look.

"—so anyone who can explain the theory to me will be *so* welcome. I can't imagine how Satya managed to do so much, so fast, and without us knowing."

"Well, I'd be happy to explain every-



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thing I know about it."

Rob waved Danny-boy away from the data display. "Sit down, sit down. I've got so many questions!"

Dixie Mae sauntered over to the desk and plunked herself down. For maybe thirty seconds, this guy would think she was brilliant.

The Ellens circled in to save her. "Actually, I'd like to know more about who we're working with," one of them said.

Rob looked up, distracted, but Danny was more than happy to do some intros. "It's just the two of us. You already know Rob Lusk. I'm Dan Eastland." He reached around, genially shaking hands. "I'm not from UCLA. I work for LotsaTech, in quantum chemistry. But you know Gerry Reich. He's got pull everywhere—and I don't mind being shanghaied for a year. I need to, um, stay out of sight for a while."

"Oh!" Dixie Mae had read about this guy in *Newsweek*. And it had nothing to do with chemistry. "But you're—" *Dead.* Not a good sign at all, at all.

Danny didn't notice her distraction. "Rob's the guy with the real problem. Ever since I can remember, Gerry has used Rob as his personal hardware research department. Hey, I'm sorry, Rob. You know it's true."

Lusk waved him away. "Yes! So tell them how you're an even bigger fool!" He really wanted to get back to grilling Dixie Mae.

Danny shrugged. "But now, Rob is just one year short of hitting his seven year limit. Do you have that at Georgia Tech, Dixie Mae? If you haven't completed the doctorate in seven years, you get kicked out?"

"No, can't say as I've heard of that."

"Give thanks then, because since 2006, it's been an unbendable rule at UCLA. So when Gerry told Rob about this secret hardware contract he's got with LotsaTech—and promised that Ph.D. in return for some new results—Rob jumped right in."

"Yeah, Danny. But he never told me how far Satya had gone. If I can't figure this stuff out, I'm screwed. Now let me talk to Dixie Mae!" He bent over the keyboard and brought up the most beautiful screen saver. Then Dixie Mae noticed little numbers in the colored contours and realized that maybe this was what she was supposed to be an expert on. Rob said, "I have plenty of documentation, Dixie Mae—too much. If you can just give me an idea how you scaled up the coherence." He waved at the picture. "That's almost a thousand liters of condensate, a trillion effective qubits. Even more fantastic, your group can keep it coherent for almost fifty seconds at a time."

NSA Ellen gave a whistle of pretended surprise. "Wow. What use could you have for all that power?"

Danny pointed at Ellen's badge. "You're the NSA wonk, Ellen, what do you think? Crypto, the final frontier of supercomputing! With even the weakest form of the Schor-Gershenfeld algorithm, Gerry can crack a ten kilobyte key in less than a millisecond. And I'll bet that's why he can't spare us any time on the real equipment. Night and day he's breaking keys and sucking in government money."

Grader Ellen—Sonya, that is—puckered up a naive expression. "What more does Gerry want?"

Danny spread his hands. "Some of it we don't even understand yet. Some of it is about what you'd expect: He wants a thousand thousand times more of everything. He wants to scale the operation by qulink so he can run arrays of thousand-liter bottles."

"And we've got just a year to improve on your results, Dixie Mae. But your solution is years ahead of the state of the art." Rob was pleading.

Danny's glib impress-the-girls manner faltered. For an instant, he looked a little sad and embarrassed. "We'll get something, Rob. Don't worry."

"So, how long have you been here, Rob?" said Dixie Mae.



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He looked up, maybe surprised by the tone of her voice.

"We just started. This is our first day."

*Ah yes, that famous first day.* In her twenty-four years, Dixie Mae had occasionally wondered whether there could be rage more intense than the red haze she saw when she started breaking things. Until today, she had never known. But yes, beyond the berserker-breaker there was something else. She did not sweep the display off the table, or bury her fist in anyone's face. She just sat there for a moment, feeling empty. She looked across at the twins. "I wanted some villains, but these guys are just victims. Worse, they're totally clueless! We're back where we started this morning." *Where we'll be again real soon now.*

"Hmmm. Maybe not." Speaking together, the twins sounded like some kind of perfect chorus. They looked around the room, eyeing the decor. Then their gazes snapped back to Rob. "You'd think LotsaTech would do better than this for you, Rob."

Lusk was staring at Dixie Mae. He gave an angry shrug. "This is the old Homeland Security lab under Norman Hall. Don't worry—we're isolated, but we have good lab and computer services."

"I'll bet. And what is your starting work date?"

"I just told you: today."

"No, I mean the calendar date."

Danny looked back and forth between them. "Geeze, are all you kids so literal minded? It's Monday, September 12, 2011."

*Nine months. Nine real months.* And maybe there was a *good* reason why this was the first day. Dixie Mae reached out to touch Rob's sleeve. "The Georgia Tech people didn't invent the new hardware," she said softly.

"Then just who did make the breakthrough?"

She raised her hand . . . and tapped Rob deliberately on the chest.

Rob just looked more angry, but Danny's eyes widened. Danny got the point. She remembered that *Newsweek* article about him. Danny Eastland had been an all-around talented guy. He had blown the whistle on the biggest business espionage case of the decade. But he was dumb as dirt in some ways. If he hadn't been so eager to get laid, he wouldn't have snuck away from his Witness Protection bodyguards and gotten himself murdered.

"You guys are too much into hardware," said NSA Ellen. "Forget about crypto applications. Think about personality uploads. Given what you know about Gerry's current hardware, how many Reich Method uploads do you think the condensate could support?"

"How should I know? The 'Reich Method' was baloney. If he hadn't messed with the reviewers, those papers would never have been published." But the question stopped him. He thought for a moment. "Okay, if his bogus method really worked, then a trillion qubit simulation could support about ten thousand uploads."

The Ellens gave him a slow smile. A slow, identical smile. For once they made no effort to separate their identities. Their words came out simultaneously, the same pacing, the same pitch, a weird humming chorus: "Oh, a good deal less than ten thousand—if you have to support a decent enclosing reality." Each reached out her left hand with inhumanly synchronized precision, the precision of digital duplicates, to wave at the room and the hallway beyond. "Of course, some resources can be saved by using the same base pattern to drive separate threads—" and each pointed at herself.

Both men just stared at them for a second. Then Rob stumbled back into the other chair. "Oh . . . my . . . God."

Danny stared at the two for another few seconds. "All these years, we thought Gerry's theories were just a brilliant scam."



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The Ellens stood with their eyes closed for a second. Then they seemed to startle awake. They looked at each other and Dixie Mae could tell the perfect synch had been broken. NSA Ellen took the dollar coin out of her pocket and gave it to the other. The token holder smiled at Rob. "Oh, it was, only more brilliant and more of a scam than you ever dreamed."

"I wonder if Danny and I ever figure it out."

"*Some*body figured it out," said Dixie Mae, and waved what was left of her email.

The token holder was more specific: "Gerry is running us all like stateless servers. Some are on very short cycles. We think you're on a one-year cycle, probably running longer than anyone. You're making the discoveries that let Gerry create bigger and bigger systems."

"Okay," said Lusk, "suppose one of us victims guesses the secret? What can we do? We'll just get rebooted at the end of our run."

Danny Eastland was quicker. "There is something we could do. There has to be information passed between runs, at least if Gerry is using you and me to build on our earlier solutions. If in that data we could hide what we've secretly learned—"

The twins smiled. "Right! Cookies. If you could recover them reliably, then on each rev, you could plan more and more elaborate countermeasures."

Rob Lusk still looked dazed. "We'd want to tip off the next generation early in their run."

"Yes, like the very first day!" Danny was looking at the three women and nodding to himself. "Only I still don't see how we managed that."

Rob pointed at Dixie Mae's email. "May I take a look at that?" He laid it on the table, and he and Danny examined the message.

The token holder said, "That email has turned out to have more clues than a bad detective story. Every time we're in a jam, we find the next hidden solution."

"That figures," said Eastland. "I'll bet it's been refined over many revs . . ."

"But we may have a special problem this time—" and Dixie Mae told them about Victor.

"Damn," said Danny.

Rob just shrugged. "Nothing we can do about that till we figure this out." He and Danny studied the headers. The token holder explained the parts that had already seen use. Finally, Rob leaned back in his chair. "The second-longest header looks like the tags on one of the raw data files that Gerry gave us."

"Yes," sang the twins. "What's really your own research from the last time around."

"Most of the files have to be what Gerry thinks, or else he'd catch onto us. But that one raw data file . . . assume it's really a cookie. Then this email header might be a crypto key."

Danny shook his head. "That's not credible, Rob. Gerry could do the same analysis."

The token holder laughed. "Only if he knew what to analyze. Maybe that's why you guys winkled it out to us. The message goes to Dixie Mae—an unrelated person in an unrelated part of the simulation."

"But how did we do it the *first* time?"

Rob didn't seem to be paying attention. He was typing in the header string from Dixie Mae's email. "Let's try it on the data file. . . ." He paused, checked his keyboard entry, and pressed return.

They stared at the screen. Seconds passed. The Ellens chatted back and forth. They seemed to be worried about executing any sort of text program; like Victor's notepad, it might be readable to the outside world. "That's a real risk unless earlier Robs knew the cacheing strategy."

Dixie Mae was only half-listening. If this worked at all, it was pretty good proof that earlier Robs and Dannys had done things right. *If this works at all.* Even after all that had happened, even after seeing Victor disappear into thin



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air, Dixie Mae still felt like a little girl waiting for magic she didn't quite believe in.

Danny gave a nervous laugh. "How big *is* this cookie?"

Rob leaned his elbows onto the table. "Yeah. How many times have I been through a desperate seventh year?" There was an edge to his voice. You could imagine him pulling one of those deathcube stunts that the Ellens had described.

And then the screen brightened. Golden letters marched across a black-and-crimson fractal pattern: "Hello fellow suckers! Welcome to the 1,237th run of your life."

At first, Danny refused to believe they had spent 1,236 years on Gerry's treadmill. Rob gave a shrug. "I *do* believe it. I always told Gerry that real progress took longer than theory-making. So the bastard gave me . . . all the time in the world."

The cookie was almost a million megabytes long. Much of that was detailed descriptions of trapdoors, backdoors, and softsecrets undermining the design that Rob and Danny had created for Gerry Reich. But there were also thousands of megabytes of history and tactics, crafted and hyperlinked across more than a thousand simulated years. Most of it was the work of Danny and Rob, but there were the words of Ellen and Ellen and Dixie Mae, captured in those fleeting hours they spent with Rob and Danny. It was wisdom accumulated increment by precious increment, across cycles of near sameness. As such, it was their past and also their near future.

It even contained speculations about the times before Rob and Danny got the cookie system working: Those earliest runs must have been in the summer of 2011, a single upload of Rob Lusk. Back then, the best hardware in the world couldn't have supported more than Rob all alone, in the equivalent of a one-room apartment, with a keyboard and data display. Maybe he had guessed the truth; even so, what could he have done about it? Cookies would have been much harder to pass in those times. But Rob's hardware improved from rev to rev, as Gerry Reich built on Rob's earlier genius. Danny came on board. Their first successful attempt at a cookie must have been one of many wild stabs in the dark, drunken theorizing on the last night of still another year where Rob had failed to make his deadlines and thought that he was forever Ph.D.-less. The two had put an obscene message on the intrasystem email used for their "monthly" communications with Reich. The address they had used for this random flail was . . . help@lotsatech.com.

In the real world, that must have been around June 15, 2012. Why? Well, at the beginning of their next run, guess who showed up?

Dixie Mae Leigh. Mad as hell.

The message had ended up on Dixie Mae's work queue, and she had been sufficiently insulted to go raging off across the campus. Dixie Mae had spent the whole day bouncing from building to building, mostly making enemies. Not even Ellen or Ellen had been persuaded to come along. On the other hand, back in the early revs, the landscape reality had been simpler. Dixie Mae had been able to come into Rob's lair directly from the asphalt walkway.

Danny glanced at Dixie Mae. "And we can only guess how many times you never saw the email, or decided the random obscenities were not meant for you, or just walked in the wrong direction. Dumb luck eventually carried the day."

"Maybe. But I don't take to being insulted, and I go for the top."

Rob waved them both silent, never looking up from the cookie file: After their first success, Rob and Danny had fine-tuned the email, had learned more from each new Dixie Mae about who was in the other buildings on the hill and how—like the Ellens—they might be used.

"Victor!" Rob and the twins saw the



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reference at the same time. Rob stopped the autoscroll and they studied the paragraph. "Yes. We've seen Victor before. And five revs ago, he actually made it as far as this time. He killed his thread then, too." Rob followed a link marked *taking care of Victor*. "Oh. Okay. Danny, we'll have to tweak the log files—"

They stayed almost three hours more. Too long maybe, but Rob and Danny wanted to hear everything the Ellens and Dixie Mae could tell them about the simulation, and who else they had seen. The cookie history showed that things were always changing, getting more elaborate, involving more money-making uses of people Gerry had uploaded.

And they all wanted to keep talking. Except for poor Danny, the cookie said nothing about whether they still existed *outside*. In a way, knowing each other now was what kept them real.

Dixie Mae could tell that Danny felt that way, even when he complained: "It's just not safe having to contact unrelated people, depending on them to get the word to up here. "

"So, Danny, you want the three of us to just run and run and never know the truth?"

"No, Dixie Mae, but this is dangerous for you, too. As a matter of fact, in most of your runs, you stay clueless." He waved at the history. "We only see you once per each of our 'year-long' runs. I-I guess that's the best evidence that visiting us is risky."

The Ellens leaned forward, "Okay, then let's see how things would work without us." The four of them looked over the oldest history entries and argued jargon that meant nothing to Dixie Mae. It all added up to the fact that any local clues left in Rob's data would be easy for Gerry Reich to detect. On the other hand, messing with unused storage in the intranet mail system was possible, and it was much easier to cloak because the clues could be spread across several other projects.

The Ellens grinned, "So you really do need us, or at least you need Dixie Mae. But don't worry; we need *you*, and you have lots to do in your next year. During that time, you've got to make some credible progress with what Gerry wants. You saw what that is. Maybe you hardware types don't realize it, but—" she clicked on a link to the bulleted list of "minimum goals" that Reich had set for Rob and Danny. "—Prof. Reich is asking you for system improvements that would make it easier to partition the projects. And see this stuff about selective decoherence: Ever hear of cognitive haze? I bet with this improvement, Reich could actually do limited meddling with uploaded brain state. That would eliminate date and memory inconsistencies. We might not even recognize cookie clues then!"

Danny looked at the list. "Controlled decoherence?" He followed the link through to an extended discussion. "I wondered what that was. We need to talk about this."

"Yes—wait! Two of us get rebooted in—my God, in thirty minutes." The Ellens looked at each other and then at Dixie Mae.

Danny looked stricken, all his strategic analysis forgotten. "But one of you Ellens is on a three-month cycle. She could stay here."

"Damn it, Danny! We just saw that there are checkpoints every sim day. If the NSA team were short a member for longer than that, we'd have a real problem."

Dixie Mae said, "Maybe we should all leave now, even us . . . short-lifers. If we can get back to our buildings before reboot, it might look better."

"Yeah, you're right. I'm sorry," said Rob.

She got up and started toward the door. Getting back to Customer Support was the one last thing she could do to help.

Rob stopped her. "Dixie Mae, it would help if you'd leave us with a message to send to you next time."



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She pulled the tattered printout from her pocket. The bottom was torn and smeared. "You must have the whole thing in the cookie."

"Still, it would be good to know what you think would work best to get . . . your attention. The history says that background details are gradually changing."

He stood up and gave her a little bow.

"Well, okay." Dixie Mae sat down and thought for a second. Yeah, even if she hadn't had the message memorized, she knew the sort of insults that would send her ballistic. This wasn't exactly time travel, but now she was certain who had known all the terrible secrets, who had known how to be absolutely insulting. "My daddy always said that I'm my own worst enemy."

Rob and Danny walked with them back to the vault door. This was all new to the two guys. Danny scrambled out of the pit, and stared bug-eyed at the hills around them. "Rob, we could just *walk* to the other buildings!" He hesitated, came back to them. "And yeah, I know. If it were that easy, we'd have done it before. We gotta study that cookie, Rob."

Rob just nodded. He looked kind of sad—then noticed that Dixie Mae was looking at him—and gave her a quick smile. They stood for a moment under the late afternoon haze and listened to the wind. The air had cooled and the whole pit was in shadow now.

*Time to go.*

Dixie Mae gave Rob a smile and her hand. "Hey, Rob. Don't worry. I've spent years trying to become a nicer, wiser, less stubborn person. It never happened. Maybe it never will. I guess that's what we need now."

Rob took her hand. "It is, but I swear . . . it won't be an endless treadmill. We will study that cookie, and we'll design something better than what we have now."

"Yeah." *Be as stubborn as I am, pal.*

Rob and Dan shook hands all around, wishing them well. "Okay," said Danny, "best be off with you. Rob, we should shut the door and get back. I saw some references in the cookie. If they get rebooted before they reach their places, there are some things we can do."

"Yeah," said Rob. But the two didn't move immediately from the entrance. Dixie Mae and the twins scrambled out of the pit and walked toward the asphalt. When Dixie Mae looked back, the two guys were still standing there. She gave a little wave, and then they were hidden by the edge of the excavation.

The three trudged along, the Ellens a lot less bubbly than usual. "Don't worry," NSA Ellen said to her twin, "there's still two months on the B0994 timeline. I'll remember for both of us. Maybe I can do some good on that team."

"Yeah," said the other, also sounding down. Then abruptly they both gave one of those identical laughs and they were smiling. "Hey, I just thought of something. True re-merge may always be impossible, but what we have here is almost a kind of merge load. Maybe, maybe—" but their last chance on this turn of the wheel was gone. They looked at Dixie Mae and all three were sad again. "Wish we had more time to think how we wanted this to turn out. This won't be like the SF stories where every rev you wake up filled with forebodings and subconscious knowledge. We'll start out all fresh."

Dixie Mae nodded. Starting out fresh. For dozens of runs to come, where there would be nothing after that first week at Customer Support, and putting up with boorish Victor, and never knowing. And then she smiled. "But every time we get through to Dan and Rob, we leave a little more. Every time they see us, they have a year to think. And it's all happening a thousand times faster than Ol' Gerry can think. We really are the cookie monsters. And someday—" *Someday we'll be coming for you, Gerry. And it will be sooner than you can dream.* ■



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SCIENCE FACT

# THE POWER OF ROTTING PLANTS, OR HOW SF SOLVED GLOBAL WARMING

Robert A. Metzger, Gregory Benford, and Martin I. Hoffert

*7.4 billion tonnes of carbon.* More than one tonne (1,000 kg) for every person on planet Earth.

That's the amount of carbon, primarily in the form of $CO_2$, that the human race pumps into the atmosphere each and every year through a combination of fossil fuel and forest burning. While some debate still lingers, most researchers believe that these $CO_2$ emissions are modifying global climates—creating a greenhouse effect that is currently increasing global temperatures.

In response to this environmental threat, an international meeting held in Kyoto Japan in 1997 created what became known as the Kyoto Accord, a document detailing global quotas on $CO_2$ reductions—not a complete solution to this dilemma, but a tentative first step in reducing overall emissions. Under this accord, the United States was to reduce its $CO_2$ emissions by 2012 to a level of 7% below carbon emissions in 1990.

Many people might remember this.

But what few remember is exactly what that reduction means in terms of actual carbon emissions. In 1990, the US emitted 1340 MtC (million-tonnes of carbon). If the Kyoto Accord were to be implemented, it would permit the US to emit only 1250 MtC in 2012. With annual US carbon emissions increasing by approximately 1.5% per year during the 1990s, this meant that by the year 2000 the US was emitting 1550 MtC—putting it 300 MtC over the 2012 target.

The US is showing no signs of slowing down on this increase of emissions, or of signing the accord. While the reasons given for not signing the accord often touch on a wide range of political and technical issues, the key stumbling block appears to be quite simple—the world consumes a tremendous amount of energy, currently on the order of 15 TW (15 million-million watts) (1). Any reductions in $CO_2$ emissions are often considered synonymous with either re-



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ductions in power production, or an increase in the cost of power production due to more stringent emission controls. Both of these paths seem to many to be damaging to the global economy.

It is very easy to paint a picture in which both these approaches represent *real* economic burdens, ones that many governments and industries are not willing to pay for. However, few would dispute that if $CO_2$ emission increases continue unabated, by century's end, global temperature increases of 3-5° C may occur. This will drive severe environmental impacts, in particular in agriculture, that would not only have disastrous economic impact, but make it even harder to feed the world's population than it is today.

The choice is often presented baldly: that nations and business must either pay for emission reductions now, or in the future be forced to pay a much higher price (in terms of both economics and lives lost as a consequence of damaged ecosystems).

But might there be another choice, a way of *effectively* reducing emissions without burning less fuel or implementing costly $CO_2$ capture technologies—one satisfying the economic concerns but still addressing the need of reducing emissions? You might think that this sounds like the beginning of an SF story, the solution to which would be found elsewhere in *Analog*.

And you'd be right—this *other* choice started off as an SF story.

Most SF writers belong to an organization called the *Science Fiction and Fantasy Writers of America* (*SFWA*). That organization produces a quarterly publication called the *Bulletin*, which provides articles, columns and market information helpful to SF writers. One of us (Metzger) writes one of these columns—a science column used to bring to the attention of SFWA members the latest science news from the fringe that they might find of use in their fiction.

As part of the column, an SF approach is taken to tackle some extreme science problems. These exercises have ranged from how to move our Sun to another solar system, to using Earth's annual production of dirty diapers to build a Saturn-like ring system that could be used to contact aliens—all very SF-intensive concepts, often played for laughs, but used to demonstrate that taking a scientific approach and melding it with an SF perspective can often lead to surprisingly practical, yet outside-the-box solutions.

One column asked, could one find a way to satisfy the Kyoto Accord by looking at the problem from a different perspective, by slipping on a pair of SF-glasses and seeing the problem in a new light?

The answer appeared to be yes.

And the miracle technology that would be used to implement the strategy was not one that typically finds its way to the head of the line of innovative high-tech solutions—our plan would rely on *rotting plants*.

When a plant rots, its carbon is emitted as $CO_2$, no different than that emitted from a tailpipe or a smokestack. So if the emissions of those plants could be eliminated from the atmosphere by storing it (*sequestering*) in some location so that its carbon content never reached the atmosphere, this would be no different from cutting back on $CO_2$ emissions from tailpipes or smokestacks.

$CO_2$ is $CO_2$, regardless of the source.

This left two key questions to be answered.

*Could enough rotting plants be stored to really make a difference?*

*Just where could these plants be stored?*

That's what we needed to find out.

This idea never saw its way into the *SFWA Bulletin*, but moved instead into the realm of peer-reviewed technical journals such as *Climatic Change*, and conferences on Global Climate Change (2, 3).



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We first needed to decide just what plants we should focus on. Was there a potentially vast source of rotting plant material useful for sequestering?

It appeared so. We decided not on just any rotting plants, but more specifically, on *crop residues*—those leftover portions of crop materials that remain in the fields after crops have been harvested. This is a ready source of plant material—a currently mostly unused byproduct of farming, left in the fields every year to rot and return its carbon content to the atmosphere. One of us (Benford) recalled driving a tractor as a boy, dragging corn stalks and husks into ditches to rot.

While it has become quite obvious in recent years that mankind has been actively reshaping global ecosystems, in essence doing geoengineering, modifying both land and atmosphere, most see this impact as a consequence of large population growth and the industrial revolution—with most considering these impacts to have taken place only within the last few centuries.

However, through agriculture, mankind has actively been modifying terrestrial ecosystems for many millennia, in humanity's single largest-scale activity. Farming currently uses about 10% of the globe's land area. Through ever more advanced and efficient farming methods we have swelled our numbers by orders of magnitude over the last several millennia. Excess food production enabled a portion of humanity to focus on other work, directly leading to the industrial revolution and the current rise in $CO_2$ levels. While farming may have started mankind down the path to our current Greenhouse dilemma, we wondered if farming could provide a partial solution.

### The Facts

Plants are machines that take solar energy, $CO_2$, water, and trace nutrients and convert them into useful chemical energy to power the plant, as well as increasing the plant's mass (where 40% of its dry weight consists of carbon). A field of corn captures about 400 times as much carbon in the form of grown plant material as there is in the annual increment of man made atmospheric carbon in the entire column of air above that field of corn—that column going from ground level all the way up to space. Harnessing this prodigious method of storing carbon could give us great leverage over the global $CO_2$ imbalance.

While worldwide human activities produce annual emissions of 7.4 billion tonnes of carbon (GtC), yielding an atmospheric carbon increase of 3.5 GtC/year, with the remaining emitted carbon removed from the atmosphere by photosynthesis and plant growth (1.7 GtC/year) and transfer to the oceans (2.1 GtC/year). As many others before us have felt—and has been discussed widely, including an article by Richard A. Lovett in *Analog* (4)— solutions to this dilemma focus on either accelerating carbon transfer from the atmosphere to other reservoirs, or bypassing the atmosphere and placing the $CO_2$ directly into other reserves—carbon sequestering.

This acceleration of carbon transfer, or complete bypass of certain segments of the carbon cycle, can be divided into two distinct approaches:

- *pre-emission* carbon sequestering, in which carbon is removed *before* emission, typically captured during the combustion process and subsequently sequestered.
- *post-emission* carbon sequestering, where carbon is removed after emission.

Post-emission processes offer an intrinsic advantage over pre-emission processes. One can view the carbon cycle pathways in which human-generated (anthropogenic) atmospheric carbon transfers to plants through photosynthesis, or to the oceans, as powerful partner mechanisms in removing carbon


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from the atmosphere. Of the 7.4 GtC annually emitted into the atmosphere due to man's activities, atmospheric $CO_2$ increases by only 3.5 GtC.

By letting the global carbon cycle work for us, it became obvious to us early on that the most effective processes are the post-emission routes, letting the global carbon cycle help. One of the earliest proposals along this line was that of Freeman Dyson (of Dyson Sphere fame) who proposed increased growth of trees as a carbon reservoir. While the potential carbon storage for such an approach can be large, it is *temporary* sequestering. The carbon will return to the air when the plants die, but it could sequester a large amount of carbon while other long-term sequestering approaches are being developed.

Other post-emission approaches include seeding the Southern ocean around Antarctica with powdered iron to increase plankton growth, in turn removing atmospheric $CO_2$. The carbon content of the plankton may sink and be sequestered in the deep ocean when the plankton dies.

We proposed a sequestering process utilizing both plant growth and deep oceans as a storage site, an approach we called *crop residue sequestering* (CRS). It takes advantage of the biosphere's ability to cycle large amounts of carbon, but bypasses the atmospheric portion of the carbon cycle, so that the byproducts of decay do not enter the air at all. We proposed sequestering carbon in unwanted crop residues in deep oceans (or possibly river deltas).

The great advantages of sequestering carbon from crop residues are that this approach:

1. uses biomass that is now mostly left to rot in the fields.
2. demands no new land.
3. uses residues that can be gathered and shipped with the same equipment used to bring in the crop.
4. requires no new technologies or transport systems to gather and ship the residues.
5. scales with population growth, since food production and therefore available crop residue scales with population growth, and
6. is a post-emission process.

### Oceans

And just how would dumping crop residues in oceans keep that carbon from entering into the atmosphere? The ocean is not really *one* ocean, but *two*—a top and bottom layer, with a boundary layer approximately one kilometer below the ocean surface, called the thermocline, through which very little vertical transport takes place.

Crop wastes shipped to the deep ocean, then sunk to the ocean floor can settle to a depth of 4000 meters, for example. It would then take about 8000 years for their decay products to reach the ocean's surface (as $CO_2$ and various hydrocarbons). And this is a worst case situation, with residues exposed on the ocean floor so their decay byproducts easily dissolve. If they become embedded beneath mud, by silting or other covering mechanisms, then this time would be much greater.

The critical point is that sequestering crop residues on or within deep ocean floors inhibits their decay byproducts from entering the atmosphere for many millennia (2).

### Crop Residue Quantity

The next question is whether there are enough crop residues available to have any meaningful impact on carbon emissions. To illustrate just how vast global agriculture has become, in the US alone, each year sees some 80 million acres of corn under cultivation (most of this raised to feed livestock). 80 million acres is some 125,000 square miles, or an area 250 miles wide and 500 miles long—the equivalent of several US Midwest states. And this is just for corn.

Each one of those 80 million acres



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produces 3 tonnes of corn, along with 4.5 tonnes of crop residue, generating a total of 356 million tonnes of residue containing nearly 150 million tonnes of carbon (2, 3).

Is this a significant amount of carbon?

Quite significant—it represents nearly *half* of the 300 million tonnes the US would need to reduce its emissions by if it agreed to the Kyoto Accord.

Adding in the other two largest US crops, soybeans and wheat, gives an additional 100 million tonnes of carbon—250 million tonnes in all; very close to what would be required to be eliminated by the US under the Kyoto Accord.

So massive carbon reserves are certainly available in crop residues. But can these really be used for CRS? Many people think that after a crop is harvested, the residues are then plowed back into the soil, an essential farming practice returning organic matter to the ground, thereby enriching it.

Not so. Historically, farmers tilled residue back into the soil, believing that it would increase the soil organic matter (SOM) content. However, research has now shown this practice leads to long-term *reduction* of organic matter in the soil, due to disruption of soil microfauna. In fact, when so called no-till methods (leaving residue on the surface) are compared to conventional tillage methods (residue plowed back in), carbon content in the soil is 30 to 50% *higher* for the no-till approach. Because of such studies, conservation tillage methods (with no-tillage the extreme) have increased by a factor of 3 from just 1989 to 1994. Nearly half of all US corn and soybean crops are now under some form of conservation tillage.

These tillage trends clearly show that more and more crop residues will become available for harvesting. In fact, the primary reason for letting crops remain in the fields is no longer due to its organic content, but to help abate soil erosion. If we assume a typical erosion abatement policy that leaves 25% of the residue on the field, as the Agriculture Department suggests, this still leaves approximately 200 MtC annually in crop residues available for CRS approaches—a significant percentage of the carbon emission reductions stipulated by Kyoto.

And if one looks beyond the US, at the world as a whole, there is potentially 1000 MtC per year in crop residues that could be targeted for potential CRS use. When one considers that man-made activities result in an annual increase of 3500 MtC in the air, a global implementation of CRS would reduce this by almost *one-third* (2, 3).

### Energy

Is there anything wrong with this logic? All it demands is gathering up crop residues before they rot and emit their carbon, then storing that carbon in the deep oceans. In the US this would reduce annual carbon emissions by nearly 200 million tonnes—a bit less than one tonne for every US citizen.

There is one quite obvious question—*is this the most effective use of crop residues?*

A first response might be to say *no*. One might wonder why go to the expense of gathering them up and then dumping them in the ocean. Couldn't they be better used?

*Perhaps.*

In the same way that gas, oil, and coal are burned as fuel to generate steam that in turn drives the turbines in a power plant to produce electricity, crop residues could also be burned. All organic material burns. In fact, rotting is slow burning, and the outcome is the same—organic material is oxidized (giving off heat) and makes $CO_2$ as a primary byproduct.

So why throw away this *free* fuel?

If one used crop residues to generate electricity, the carbon would be returned to the air (as happens now after every harvest). This results in no net increase in atmospheric carbon (since the carbon in those residues was originally



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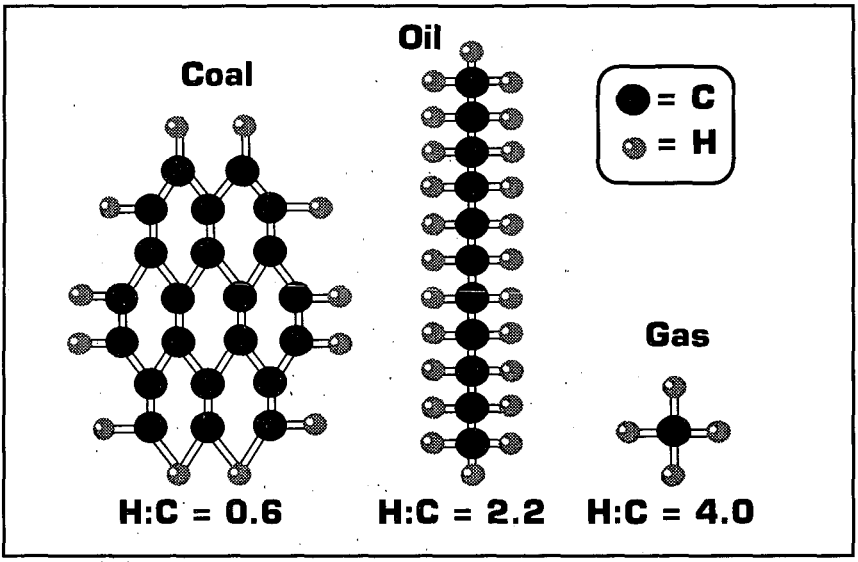


**Figure 1** Carbon emitted per unit of primary energy released by combustion (C/E) increases as the H:C ratio decreases, therefore making methane the least $CO_2$-emitting-per-unit-energy-released fossil fuel, and coal the greatest. Reference: Ausubel, J.H., "Where is Energy Going?", *Indust. Physicist* 6, 16-19, 2000.

pulled out of the atmosphere as the plants grew), while yielding energy. That energy would then go into the US power grid, so less power generation would be needed from a conventional oil/gas/coal fired power plant, and therefore less atmospheric $CO_2$ would be generated for an overall same amount of energy production. So what would be the sense in tossing crop residues into the deep oceans, when they could be used to produce power and effectively reduce $CO_2$ emissions?

*The answer is that not all fuels are created equal.*

All organic material will burn, but the amount of energy liberated for a given quantity of material varies greatly depending on the hydrogen content of the material. Figure 1 shows the organic structures for some typical fuels: coal, oil, and methane (gas), where the hydrogen/carbon (H:C) ratios are 0.55, 2.2 and 4.0, respectively. Wood, which is very similar in structure to crop residues, is mostly a mixture of cellulose ($C_6HO_5$) and lignin ($C_{10}H_{13}O_4$), typically 80% cellulose/20% lignin, and has an H:C ratio of approximately 0.1—therefore five times lower than coal and 40 times lower than methane—these values reflecting the large amount of carbon in those molecules. What makes this ratio so important is that the lower the ratio, the larger the amount of carbon released during burning (oxidation process). Consider the case for the burning of methane ($CH_4$).

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O\ (g)$$

Every atom of carbon present in the starting organic fuel produces a $CO_2$ molecule. The more carbon present in the fuel, the more carbon liberated during burning. The energy that this chemical reaction produces during the burning process is simply the difference between the heats of formation of the reactants ($CH_4$ and $O_2$) and the products



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**Table I**

| Fuel | (E/C) TW-yr/GtC | (C/E) GtC/TW-yr. |
|---|---|---|
| Methane | 2.1 | 0.48 |
| Oil | 1.6 | 0.63 |
| Coal | 1.3 | 0.77 |
| Wood | 1.1 | 0.91 |

($CO_2$ and $H_2O$), where in this case the resulting energy release per unit of starting material is 803 KJ/mol.

Unless one is a chemist, this value does not lend itself to an intuitive feel—does not tell us if the penalty of $CO_2$ production for the energy liberated makes this a good fuel. So by performing the same energy liberation calculation for typical fuels and by examining the ratio of energy generated (E) to the amount of carbon byproduct (C) in the form of $CO_2$, we can compare the merit of various fuels. This is illustrated in Table I, where energy units, E, are in Tera-Watts-year (TW-yr) and the carbon content is in billion tones of carbon (GtC). These units were picked because they reflect annual global energy produced (currently about 15 TW-year) and annual global $CO_2$ emissions (currently 7.4 GtC).

Table I demonstrates that to produce equivalent amounts of energy from methane and wood burning, nearly twice as much $CO_2$ would be generated if wood, a material with a very similar H:C ratio to crop residues, were the fuel source. So while crop residues would represent a source of fuel that could be used for power generation, it produces *twice* as much $CO_2$ emission as methane. It should be noted that currently the global C/E ratio (where energy production from all sources are included) is at 0.56—placing overall global efficiencies approximately midway between that of methane and oil burning (3). It is anticipated that by the year 2030, this ratio will actually fall below 0.48 (that of methane) due to the increase of carbon-free energy production that can be obtained from such sources as nuclear, solar and wind. From a carbon emission standpoint, the trend is clearly away from carbon-rich fuels, of which crop residues would be the extreme example.

Using these values, one can examine the best usage of crop residues with respect to energy production and carbon emissions. Consider the 250 MtC in US crop residues. If used as a fuel with a C/E ratio of 0.91 GtC/TW-year, this source would generate 230 GW. Under such a scenario, there is no net loss or gain in carbon emissions, since had the crop residue not been used as fuel, it would have rotted and released its carbon into the atmosphere—the same amount of carbon liberated by burning. If instead of burning the crop residue to generate power, it were permanently sequestered in the deep ocean, 250 MtC would have been removed from the atmosphere. Then by using a methane-fired power plant to generate 230 GW of power (the same amount as had been generated by the burning of the biomass), in which the C/E ratio is only 0.48, the 230 GW would result in the emission of only 132 MtC. Therefore, while the burning of crop residue produces no net carbon emissions, the combination of sequestering and using a gas-fired power plant actually removes [250 MtC-132 MtC] = 118 MtC from the atmosphere, while producing the same amount of energy.

What this example illustrates is that as long as there is any source of fuel with a smaller C/E ratio than that of crop residue (which includes all conventional organic fuels used in power generation, including coal) it is always more efficient and less $CO_2$-polluting to sequester crop residues in the deep oceans and



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generate power in conventional plants.

The CRS approach clearly shows that it is possible to reduce global carbon emissions by the levels stipulated under the Kyoto Accord without reduction in global energy production or implementing costly modifications to existing power generation facilities in order to increase $CO_2$ capture. Furthermore, this approach requires no new technologies, no additional infrastructure costs, no increased land use, and any revenues generated (it is estimated that carbon credits for $CO_2$ may be valued between $50 and $200 per tonne) would go to those producing the crop residues, i.e. the farmers.

In the same manner that the Kyoto Accord does not represent a total plan to eliminate $CO_2$ emissions, CRS does not represent a total solution to eliminate $CO_2$ emissions. It represents a partial solution, and what we feel is an important perspective—that by understanding the global carbon cycle, by investigating how it works and how it can be influenced, other novel solutions will be developed—beyond those based on the old standbys of burn less fuel, or capture more emissions from the smokestacks. All one needs to do is slip on a pair of SF-tinted glasses and take a look at the possibilities. ■

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# A New Man

## Shane Tourtellotte

If a person undergoes a fundamental, internal change, to what extent does he remain who he was?

She saw them across the street, two doors down. There were a couple of video cameras, at least one reporter, and close to a dozen other people. She made sure the baby was all right in her crib on the porch, then went to the low fence between houses, where Mrs. Viselli was clearing weeds from her side-yard garden.

"What's going on at the Muntz place?"

Mrs. Viselli struggled to one knee, and leaned over to look past the corner of her house. "Oh. They must be bringing Josh home."

"Who's that? I knew they had a grown daughter, but I thought that was all." She could now see two policemen approaching on foot.

"No. They . . ." She almost stopped. "You may as well know, Elena. Long ago, the Muntz boy attacked three women. Killed . . . I think it was two, but maybe the first one lived."

Elena recoiled. "I never heard about that."

"It's not something we talk about casually. We've been trying to live it down for a while." She knelt back down, and her voice grew tart. "Maybe we never will."

The police were talking to the onlookers now. "What happened to him? Did he just get paroled?"

"Never went to prison. He was found insane, institutionalized—but they've given him that new treatment, and they say he's cured."

A car pulled up in front of the Muntz house. It bore no markings, but still managed to look official. The cops took positions by the doors, while a second car pulled up behind it.

"He got the brain wipe?" Elena said.

"Yes, that's what they call it. Of course the news gave a much longer explanation, about putting someone else's normal brain patterns in the sick areas." She grunted, and tossed aside a large weed with a spray of dirt. "Better if they erased the whole brain, maybe."

Elena didn't hear the last part, as she had fixated on the figure emerging from the car. He was tall and wore a cap, but she couldn't see much else. The cameras, including one from the trailing car, followed him up the walk. Shouts rose from the small crowd. A policeman pushed one person away after he got too close, and when a couple tried to block the walkway, the other cop had to brandish a stunner to move them aside.

Josh Muntz didn't seem to react, but Elena was in a bad position to see if he



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did. "Are we going to have this happen every day?"

"I doubt it. Maybe a protest or two, and the news'll run profiles of Josh. Just enough to blacken our reputation all over again."

As Josh and his escort reached the door, Dinah Muntz appeared. She said a few words to the police, and took her son inside with an arm draped around his shoulder. She gave no acknowledgement to the cameras pressing in, and the blinds had been drawn in advance.

"Nobody told me," Elena repeated. "Nobody asked us whether we wanted this."

Mrs. Viselli looked up. "Nobody had to."

Before Elena could reply, she heard fussing. She went to tend the baby, and that odd interlude was over.

Josh Muntz wanted to be alone. He hadn't been in this house, or anywhere outside the facility, for thirteen years. It was strange and oppressive, and he wanted to detach himself from it, to sink into a somnolent fugue where nothing could reach him.

Mother wasn't allowing that, with all her fussing—and she was right. Isolation had been a symptom back then: the long stretches spent in his room, doing nothing, refusing to look for a work or school position, to see friends, to interact in any way. If he gave in to that now, Mother would think he was right back where he started, and that would be too horrible for her. And for him.

Mother had shown him all around the house, and now was puttering in the kitchen, starting to get dinner ready. Josh snooped into the refrigerator and cupboards, looking over the food with a vague anxiety. Perhaps the variety unsettled him, after so many years of institutional feeding. Soon he stopped, letting Mother work unhindered.

It pained Josh to watch her. He knew she had aged, had seen the hair graying and wrinkles deepening on her visits to the California Medical Facility. What he hadn't seen was her slowing down, beginning to bend under the burden of age. She wasn't that far from retirement, and now she had a son to care for all over again.

"Here, Mom, let me do that."

She instinctively pushed his hand away. "Oh, I didn't mean that, Josh, but it's my gravy, and I know how to stir it. You just sit down and relax."

He tried, but a minute later he was up again, setting the table. She chided him, weakly. Soon, she gave him the task of fixing the peas. "But not in the microwave. They're never any good from the microwave."

That was a relief, because Josh didn't remember how to use one. He had enough trouble judging the right level of a boil for the water. Mother was itching to intervene, but held off.

They heard someone on the front stoop. "That must be Owen," she said. A couple of minutes passed, though, with no one entering or ringing the bell. "What's keeping him?" Dinah said, as she headed to the door. "Now don't touch anything."

Josh couldn't stand the suspense for long, and peeked into the front hall. Mother was closing the door. "Owen, you don't have to speak to them. Why can't they—" She saw Josh, and stopped.

Owen saw him too. He took a few stiff steps forward. "Hello, son." His gaze wavered, then came back. "I'll be cleaning up," he said, and headed upstairs.

His father always washed and changed after a day at the auto shop. Putting off more intimate greetings was never a slight, if you understood the man. When Father returned, though, he was little warmer. He hugged his son as though it hurt. Josh could think of nothing to say.

He hesitated before sitting down to eat, then remembered his cap. Old manners clung to him. He took it off, expos-



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ing the stubble on his scalp growing over the surgery scars, and trying not to notice as his parents' eyes turned and lingered.

Dinner was quiet. Josh told them about the custodial job he'd be starting in two days, on a graveyard shift beginning Sunday night. "I'll try not to make too much noise leaving or coming back. I'll be doing one or the other while you're sleeping, until they trust me enough to give me a daytime shift. If it's too—"

"Don't worry about that," his father said. "Do what you need to." He took a bite, frowning. "The . . . hospital arranged this job?"

"Yes. It's part of the trial program."

"Right. So why couldn't they arrange housing, too? They have halfway houses."

"Owen, we went through this. Family support will help Josh readjust."

"But those other families—"

"Moved out of state. The university couldn't monitor them properly if they were with their families." She pushed out a smile. "It's lucky for Josh we stayed nearby. He needs us, and he has us."

Owen looked at his son. "Yeah. You've got us."

After dinner and a tense hour in the den, Josh finally went to his room. The furniture was the same, and a few other familiar items had endured his long absence, but the room still felt barren. He looked over the bookshelf, but no title struck him as anything he cared to read. Half were old textbooks, dry stuff. The others were juvenile, not him at all.

His door remained ajar. He didn't want them thinking he was closeting himself away. He kept his movements quiet, so he wouldn't disturb them, and they could talk without interruption.

The one obviously new item was the computer center on his desk, a low-end model. He turned it on, and reluctantly went to the news. He didn't want to see the coverage, but it was a matter of responsibility, not preference.

The automatic audio stream was the first thing to download, and he turned off the sound. The video was from his walk to the house. It showed the shouting man plainly, but no caption identified him, and the short text story didn't give his name either. Josh raised the volume a notch, leaned close to the speaker, and dragged the progress bar back.

"What about Karen? Who's going to give her back to us? You?"

Josh winced, recalling this part quite well. He went farther back.

". . . this forceful reaction from John Parr, the father of Muntz's first victim."

Josh cranked the sound off again, and fought to push away the memories. By the time he could stand to listen again, a younger man was speaking.

". . . this rewiring in secrecy. They didn't tell me, or my parents or my sister, until the day before yesterday, when they said they were releasing him. They never consulted the families. They never asked us!"

*They never asked me.* It was all decided by his caseworkers, and his parents giving informed consent. *It isn't my fault.*

He was able to gather some names from the news stories, and one home city, but nothing else. He thought of digging deeper, but refrained. His computer might be monitored, and he didn't want to give them any reason to swoop down on him.

Was it paranoia and delusion to think that, or recognizing their caution? He left the question unexamined, but shut off the computer.

It was still quiet. He listened, but heard not a murmur downstairs. He had hoped to overhear them, to get some idea of what they thought of all this in their unguarded moments. His parents simply weren't speaking tonight.

Was it the estrangement he had feared? Or did they no longer have unguarded moments? He hadn't had any for years and years—but he had been



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constantly under watch all that time. That taught you new behaviors.

Josh started rearranging the room, for activity as much as comfort. He looked in the drawers for room to put away some items. The top ones were filled with clothes bought for him in the last few days. The bottom one—apparently his parents had used it for the same purpose, putting things out of the way.

Half a dozen Joshes looked up at him. The photos were of various ages, the oldest from when he was about twenty. Josh picked that one up. His hair was shaggy, his eyes dark and sullen. He had no smile, but those of his parents were bright, still full of confidence and promise.

He felt no connection to that man, that boy; no tug of a reminder how to live an ordinary life. Then again, that Josh hadn't known how to be normal either, how to translate his smarts into good grades, how to hold a job or friends, or even how to look for a girlfriend.

Even thinking of that brought on a flood of horrible memories. By the time he fought them down, he couldn't stand to look at that photograph any longer. Was it even him in that picture? That person had changed too much, mutating from a listless youth into a lunatic killer. Then the treatment, the patterns of a healthy person's brain impressed over dysfunctional portions of his, making him—what?

*Whatever I am now*, the rational part of him said, *and whatever I make of myself.*

He got ready for sleep, before the night stretched too far. Soon the lights were off, he was in bed, and he was left with nothing but himself, and time to think.

"You get nervous when I look at you?"

Josh shook his head fast. Rafe Lilly had been showing him through the basement of the municipal building for five minutes. That was too soon to get fired, no matter what his shift boss's attitude was. "No, sir."

Rafe gave him another of those looks. "I do know where you've been, but I'm buckling down on you because you're new, not because of where you were. I've worked with people coming out of bad places before, you know. Part of the job here."

"Oh. Do we, uh, they usually work out?"

"Some of you do. A few don't." His smirk faded. "I hear you're a special case."

Self-consciously, Josh's hand brushed his cap. "I guess so."

"Hm. I hope they helped you. Still, that won't make me any softer on you. I'm gonna watch you close, make sure you learn what you've gotta do, so eventually you can do it without me looking over your shoulder."

He raised a finger at Josh. "And I'm gonna keep you awake. Some folks on night shift treat staying awake the whole eight hours as optional. I don't."

"Don't worry about that, sir," Josh said with a misshapen smile. "I won't have any trouble staying awake."

Josh got home just as his parents were going to work. He woke up just as they were coming home. What was dinner to them was breakfast to him, but they had it together.

Silence fell once Josh's small talk about work ran dry. Owen soon broke it. "There's a news show that wants to interview us for their program, Josh. All three of us."

"Owen," Dinah said, "we weren't going to bring that up. Josh shouldn't be pressured about it. None of us—"

"He can make his own decisions, Dinah," Owen said, his voice rising.

"I don't want to be on TV," Josh broke in, "or NV, or whatever it is. That's my decision."

Owen's mouth grew hard. "All right, son. I understand." He carved up the last of his meat. "But we can make our



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own decisions, too."

Looks passed between Owen and Dinah, freighted with meanings Josh did not understand. He drifted back to his meal, letting the chill descend upon the table.

"I don't understand why Dad wants to expose the family to that scrutiny. Especially himself." He let his head nestle into the soft back of the chair.

"Would he normally shield himself more than you or your mother?" Dr. Tranh's voice was soft and unthreatening, like everything about him from the décor of his office to his peach-colored shirt to his flat, bland face.

"It's just how he's handled this throughout," Josh said. "He almost never visited me in the facility. He must have been shunning me, trying to deny that I was connected to him. Mom didn't talk about it much when she visited, but you could tell she resented it, and him. I'm kinda surprised they didn't split up after I got put away. Thirteen years of such tension is a long time." He chuckled. "Maybe they stayed together for the sake of the children. More misery because of me."

"Josh, it's pointless to take that blame upon yourself. They have control over their own actions. Besides which, there was nothing you could reasonably do to influence their actions while you were under special care."

Josh suppressed a wince at the euphemism. "It's what I could have done before, Doc. Or what I could have not done. I know you'll say I wasn't responsible, but nobody else was there, doing . . ." He recovered fast, before Tranh could latch onto that. "Maybe I should do this, go on television. There are people I have to talk to, to tell things. This might be the best way."

"No," Dr. Tranh said quickly. "Your responsibility now is to your own well-being, not anybody else's. Directing your therapy toward others can hinder your own recovery. You are your first priority. If you need to examine these feelings, this is the place for that."

Josh wanted to argue with Dr. Tranh, but the urge sank down, merging into the knot within him. "The way everybody talked about this surgery, I thought I was cured, the illness gone, the violence erased." He looked at his hands. "I don't feel violent. Of course, I never felt violent except during the urges. Just a few months out of my whole life. I thought I'd have some residual trouble readjusting, coming to terms with my past. I still think that's really all I need."

Tranh shook his head gently. "Mental wellness is a lifetime process, Josh. Integrating into society is continuous, and so is integrating with our own personality. This is something that will be with you the rest of your life." Josh sank into the chair. Tranh didn't notice. "Tell me why it's so important for you to explain your actions to other people, and who these people are."

Josh stared at him. "Isn't it obvious?"

"Not until you tell me."

"It was frustrating." Josh winced as Dr. Peale placed one of the head clamps. Even through the padding, it was cold. "I try to get to the bottom of something, but he deflects me, as if my worries are overblown. It's like he doesn't just have all the answers, but all the questions, too. Dr. Trank's not helping me much."

Lucinda Peale backed away. "Trank? I thought his name was Tranh."

"Oops. That's his nickname in the facility, among patients. He's so laid-back, guys joke that he's, uh, self-medicating. Listen, this isn't gonna get back to people, is it?"

"Relax, Mr. Muntz. I'm not going to tattle." She cocked her head, listening to her ear-piece. "Okay, they're ready in the booth. We'll set the baseline now."

Light classical music began to play in Josh's ears. He tried to sit back, but the head clamps held him fast. The design of the magnetoencephalograph was new, letting the patient sit instead of ly-



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ing down. The head was still immobilized, but the patient could see and hear much more.

It probably helped claustrophobes cope, Josh thought, but it wasn't a problem he had. Enclosed spaces were comfortable to him from before his illness, and especially during his confinement. Odd, then, that he felt relief at having an open scanner here.

"Maybe you could help me switch psychologists," he said to Dr. Peale. "Maybe, if the project doesn't have you too busy . . ."

"I'm a neurobiologist," Peale said, "not a psychologist. I may be able to help restructure brains from within, but not from without. It's not my field."

"You might be better than you think. You've got a good manner with me."

Peale colored, then frowned. "All right," she said to the voice in her ear. "Please stay quiet, Mr. Muntz. We have to restart the baseline."

"Okay." Under his breath, he added, "And call me Josh."

He stayed quiet and calm, thinking as little as possible about what was to come. He had been in this room before, once as a potential subject, once before his surgery, and once after. They always asked him about his crimes. They needed to see how his brain reacted, which neurotransmitters were produced and reabsorbed. They needed to see whether the changes the surgeon had wrought persisted.

The MEG was supposed to be a noninvasive scanner. The interrogations put the lie to that.

Peale stopped her pacing. "Okay, we have our baseline." She flipped down a small video screen in front of Josh, and backed away to a chair next to a control panel. "Now, when you're ready, we'll start with your recollections of Karen Parr."

Josh saw her cross her legs tightly. He made his voice gentle, unconsciously mimicking Dr. Trank. "You're still afraid of me, aren't you?"

Peale made two energetic false starts, then subsided into thought. "Yes," she finally said. "Violence frightens me. I've been around violent people the last few years on this project, talking them through their acts of . . . It should have inured me. Knowing the overlay procedure as intimately as I do should convince me that you are no threat. I really believe you aren't, but I still cannot shake this primal fear. It isn't your fault. It's mine." She groaned. "I shouldn't be saying this."

"It's all right. You shouldn't want to be unafraid of violence." His voice caught for an instant. "But you've got an escape route. If it's ever too much for you, you can separate yourself, switch to another project, leave the violence behind."

Peale's frown lightened. "We're actually trying to do that. We're expanding the uses of—" She stopped, listened, and turned testily toward the curved mirror set in a corner of the ceiling. "Okay, Pavel, I know." She looked back. "We need to start the interview now, Josh. Karen Parr."

"All right." Josh fixed his eyes on the screen, and fought down the surge in his chest. If she could face these things, so could he.

Josh got off the bus, still feeling logy even with bright afternoon sunlight beaming down on him. He started walking the four blocks to home, passing people on the sidewalk. None of them turned aside, obviously looked away, or verbally accosted him. Not his neighborhood yet. Not people who knew who he was.

He had gotten off work early that morning, as usual. After a week's scrutiny, Lilly was thinking of shifting him to evenings soon. Josh had enough reason to stay in Lilly's good graces; this was just one more.

Josh had gotten a few hours of sleep at home, before he had to go to his latest therapy session. Dr. Trank thought it



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some breakthrough that Josh said how bad he felt about the attacks, about having killed a woman and left another brain-damaged. Good God, how *couldn't* he?

He had felt that remorse before the overlay, in a disjointed, apathetic way, the same way he felt most things back then. Now he felt it all, like the surgeon had never closed his skull. For someone so solicitous about his feelings, Josh thought, the doctor wasn't helping much with them now.

Trank still wouldn't sanction his approaching any of the victims' families. Not self-directed, he maintained. No, can't have any catharsis.

Josh didn't mention to him that one note dropped through the mail slot at home, from the brother of one of his victims. Josh didn't want him in trouble. Still, he hoped the guy wouldn't follow through.

He rounded the corner onto his home block. He heard a door close, and saw an old woman across the street stiffen her back as she worked in her garden. A younger woman was approaching him on the sidewalk. She wasn't from the neighborhood; she couldn't know who he was.

She picked up her pace, and he realized he was wrong. She knew him; she was looking right at him. Was she from one of the families? He didn't think so. Before he could try again to place her, she was right there.

"Joshua Muntz?"

"Uh . . . yes. I'm Josh Muntz." He braced himself.

"Hi. I'm Kadie, Kadie Casimir. I'm with CRCRI. That's Californians for Restoration of Civil Rights to the Incarcerated."

Josh looked at her in incomprehension, and started walking again. "I'm sorry. I've never entered into political causes."

"But this is *your* cause." Kadie kept pace with him, gesturing expansively as she spoke. "The law has stripped you of your right to vote, because you were institutionalized for . . . your acts." She regained her momentum before Josh could fire back a riposte. "It's a permanent injustice, imposed on the basis of a temporary sentence. Well, really no sentence is justification for depriving you of civil rights."

"I've never voted, either." As he said it, he remembered he had once. Admitting it would only encourage her, but he thought about it.

"That isn't the point. Look at you now: after the overlay, you're fully rehabilitated. It's scientific fact. You're a living example, refuting the injustice that we want to reverse. You can speak for people like you, who have been rehabilitated, or who still languish in incarceration, denied their fundamental rights. We want you to be a spokesman for us."

Josh stopped at the walkway to his house, disturbed. "I'm not political," he said in a weak voice. "I've never cared."

Kadie's smile disturbed Josh worse. "Well, maybe that's not true any more. Your pattern donor—a lot of them think as we do. Some of their enlightened ideals may have been part of the healthier patterns imprinted onto you."

Josh felt himself turn to lead. He could barely make himself move up the walkway, away from this woman. He couldn't form any words to speak.

"It's no reason to be afraid," Kadie called after him. "It's a better you. Don't reject it."

He didn't stop until he was inside and closing the blinds. He lifted one up an inch, watching her slow retreat. He had the impulse to call her back, which scared him most of all.

"Imagine her nerve!" Owen Muntz said. "I hope you tossed her out of this house."

"She wasn't in the house." Josh followed his father into the kitchen, where Mother was taking a bowl out of the refrigerator. "I turned her away, but—is it true?"



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"Is what true?" Dinah asked.

Josh turned to her. "Mom, when I was younger, did I ever raise a fuss about engineered foods?"

Dinah thought. "No. Of course, I don't buy engineered foods. They never completely got their reputation back, and they're still a little pricey."

Josh gave a pained smile. "I'm relieved—and that's what worries me. I never cared when I was young, I never thought about it in the facility, but it matters to me now. Isn't that strange?"

He took a hesitant step toward his father. "Dad, what do you think about this drive to legalize polygamy?"

Dinah gasped. "Joshua!"

Owen bristled. "What do you think? Don't tell me you're in favor of that!"

"I—I don't know. It was a fringe idea before I went away, and it still is, kinda. But I looked at the story in the paper after I got home, and something inside me said, 'Yes. Good.'"

"Is that how they filled your head in that hospital? Is that what *we* taught you?"

"No, Dad! That's the point." He raised a shaky hand to his temple. "Have I got someone else in my head? Did those scientists put him there?"

Dinah put her arms around his shoulders. "Josh, dear, that woman's unnerved you. You're still recuperating, readjusting. Really, she had no business saying such things to you."

"Yeah," Owen said, "but what if she was right?" Two heads snapped around. "We heard that talk, Dinah, back when we were being briefed on the operation. Those politicians getting their brain patterns taken, used on people."

"Dr. Patrusky assured us none of that would get carried over," Dinah said. "All the rest was just political smearing. You know better. Don't listen to this," she said to Josh.

"And you know it isn't your political ox being gored." Owen leaned across the kitchen table toward them. "Maybe there's something to this. Maybe they don't know as much as they think they do."

Josh could feel his mother's demeanor change, as she let him go to confront her husband across the table. "Oh, better that than somebody might pin something bad onto you, right, Owen?"

"Do you want this to be my fault? Do you want to drag this argument out of its grave?"

"Stop this," Josh said weakly. "I never said it was your fault, Dad. How could it be?"

"Oh, you'd be surprised what blame some people can spread around. Some of those studio experts—" He put a scornful fillip on the words. "—during your trial were playing up the 'genetic component' to mental illnesses. Heredity. Us." He jabbed his thumb at Dinah and himself. "Making us complicit, responsible. They liked that conclusion better than the obvious one."

"That's not what this is," Josh tried to say, but his mother was already shouting.

"And you can't stand that, bearing any responsibility for your own son, so you tried to deny even that." She wheeled on Josh. "He got DNA tests."

"*Dinah!*"

She ignored him. "To see if you were his son. He was hoping I might have gotten knocked up by some random pedestrian, taking him off the hook."

Josh staggered back to the wall, glad for something solid behind him. Father was looking his way, his arms out.

"They kept pushing their agenda, day after day. They drove me past my breaking point. I tried to make her understand, to get some forgiveness—but she had to drag your sister into it. She did her own tests for Mary, to throw them in my face, to imply there was some doubt about that!" He pointed at Dinah. "And now you've dragged him into it. Now no one is spared."

"There you go again, shifting blame. It's never you. You never have to pay!"

Owen's hands fell, bunched, at his



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sides. "I've paid. For thirteen years, I've paid: with everyone who knows my son was a killer and insane, with however many millions more will know when that interview goes on TV. It's Purgatory, but if you go through enough Purgatory, it's supposed to end. I thought it might be ending, but now, if he's got voices in his head . . ."

They ran out of invective for a moment, just long enough for Josh to flee the kitchen and bolt upstairs. He heard their voices rising again, and shut the bedroom door on them. He tried to shut his mind to them as well.

He had put off going online, for fear of what he might learn. He sat down now, and started looking up information on brain template donation. He soon discovered a dispute as acrimonious as he had feared, sometimes as bad as what was going on downstairs. He found lots of conclusions, but nothing conclusive.

"—your self-indulgent breast-beating, you won't face—"

Josh covered his ears until his mother's voice faded back into indistinctiveness. He cleared the screen, and stared at it. He had postponed looking up any of those addresses, too. Was it something he even wanted to do, with the protective surveillance they might have on him?

"—enough of 'me' and 'my,' Dinah. What about 'our?' Our son—"

Well, looking up the overlay pattern debate had probably raised flags. Might as well go all the way.

Dr. Peale glanced up from her work, and saw him in the doorway. "Mr. Muntz! Were you looking for me?" He barely nodded. "How did you know I'd be here on a Saturday morning?"

"I didn't. I just tried here."

She stood up. "You . . . look like you're in rough shape."

"I had a bad night." He shuffled in a step. "Is it true, Doc? Did overwriting my neurons give me the political ideas of another man?"

He watched her jaw stiffen, then move in slow, milling motions. "Mr. Muntz, you know we restricted the overlay to the areas in your brain implicated in your illness. Despite that narrow focus, theoretically there could be carryovers beyond the transfer of a mentally stable pattern. A lot of people have gotten worked up about this, but all their evidence is anecdotal. There is no scientific evidence that this happens, or that it has any noticeable effect on the patient."

"Well, chalk up another anecdote, because it happens." He took another step, and Peale drew back. "Did you pick the politicians yourself?"

"No!" Her head dropped, and she murmured something about God into her hands. "Sit down, please." He didn't move.

"Mr.—Joshua, I made a hard decision, a compromise that saved our program when the State Assembly could have left it to wither and die. We've done a lot of good we otherwise couldn't have, but that hasn't made me forget our original . . . compromise. We've added many more templates to our catalog since then. Those politicians are a minority now. If we haven't completely balanced their particular inclinations," she said with a hopeful smile, "we've definitely diluted them."

"But you left them in your catalog?"

She nodded. "Compatible templates aren't automatic. It's like organ donation. We need a deep pool."

"Was mine one of theirs? Or maybe someone like-minded, who didn't want the pool diluted?"

Peale's shoulders slumped. "I don't know, and I couldn't find out. Donors have confidentiality rights." She took a tense breath. "I want you to consider that excess overlay isn't the only explanation for any peculiarities in your thoughts. Could there—please, I'm not being insulting in asking, but—"

"Multiple personalities?" Josh shook his head. "MPD's an extreme form of



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neurosis. I was diagnosed schizophrenic, though they never pinned down what kind. Some said it was mainly catatonic; a few said paranoid. Blending of symptoms is pretty common, it turns out. Probably what makes people confuse schizophrenia with split personalities."

He laughed, then saw that that unnerved Peale. "But it isn't MPD, and I never heard voices. I don't hear them now. It's just that my own internal voice says things I don't expect." He felt the nervous energy trickle out of him, and he pulled over the chair Peale had offered him. "You've got to do something for me, Doc," he said as he folded into it.

"I want to help you," Peale said.

"Then send me back into surgery. Rewire me so . . . you probably can't remove his thoughts, but make it so I don't mind them. Make me oblivious. Make me happy."

"Josh, we aren't close to being able to excise individual thoughts, and ethically—"

"Oh, right, ethics. Then what about my memories? Can you block out the attacks?" Her expression gave him the answer. "How about something simple: disengaging my sex drive?"

"What?" Peale needed a moment to regroup. "There was no sexual component to the assaults, was there?"

"It's not about the assaults. Except it is." He tightened, bent a little upon himself. "No decent woman would want a man who did those things. No woman should. Even if I'm better now, I'd have to come clean about my past. Inflicting those horrors on someone I cared about . . . terrible, just . . ."

Peale cautiously pulled her chair closer. "Joshua, I need to know this. Are you feeling any urges that you experienced . . . before?"

Josh snapped out of his seat. "No! Doc, that's the part you got right. I don't think I could hurt anyone if I tried." His face convulsed once. "It's all the rest that's giving me trouble."

Peale nodded, and pushed her chair back to the desk. "Let me call someone for you. Not Dr. Trank—I mean Tranh. I know another psychologist—"

She had turned to her computer. Josh took that moment of inattention to slip out and hurry down the hall. Peale shouted as he turned the corner, but he heard no sounds of pursuit.

Josh was beginning to think he was lost. He hadn't printed a map or brought a pocket-comp, and in his precipitate departure from the university lab he could have hopped the wrong bus. His memory for the streets might not be so sharp either. Just one more thing wrong with his brain.

It didn't matter. He'd keep walking. Whether he found it felt almost secondary.

But there it was, right ahead. He had even delivered himself to the right block. He hadn't gotten himself lost—and he almost regretted it.

He walked up the street, tugging his cap down, keeping his head low. He counted the numbers, and spotted the little run-down house that was his destination. A second later, he stopped in his tracks.

There she was, sweeping the porch listlessly. He had an oblique look at her, and it was hard to see the person she had been. More than time had altered Karen Parr's face. The intellectual light had vanished, and taken all of the beauty with it.

No, it hadn't vanished, hadn't peacefully evaporated. He had bludgeoned it out of her.

He walked again, assuming the most passive posture he could. He didn't know whether she would even recognize him—until she looked up, and froze. So did he.

She began a fearful grunting, and backed away, gripping the broom tighter. Soon her back reached the wall, and her voice rose to a wavering keen. It sounded just like she had after his first



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blow had struck: the same terror, the same desperation. He remembered his own desperation, too, as he swung again to silence her—

He took a last step forward, arms out, pleading harmlessness. That drove her keen into a shriek. The front door flew open that instant. An older woman rushed out, speaking rapidly and soothingly. A man came right behind, and his gaze fixed on Josh.

He knew John Parr from the news clips. He knew for certain that Parr knew him.

"Get her inside," he told his wife, as he stormed down the stairs. "And call the police!"

Josh didn't run. "I'm sorry. I didn't come to upset her, or anyone. I—"

"You shouldn't have come here at all!" Parr stopped inches from him. "What business can you possibly have in our home?"

"To apologize." Josh was starting to shake. "To begin to make some kind of amends."

"To what? Oh, it's way too late for that. You can't restore my daughter's mind. You can't undo the last fourteen years."

"I know that, sir."

"Do you know you can't bring Sarah Abel back to life, either? So this isn't about making amends. You're here to make yourself feel better—and I don't *want* you to feel better! Nobody in this family does!" He took a step back, grinding a fist into his palm. "You are lucky my son isn't here. What he'd do to you . . ."

"He told me what he'd do. I took that chance." That deflected Parr's wrath for an instant. "It's important for all of you to understand, even him, especially him."

There was a last muffled shriek from inside the house. "Understand what?" Parr demanded, his anger rekindled. "That some machine has washed away your sin and absolved you? That you're a new man?"

The last words caught Josh off guard. "You're sneering at that, but I think that's what I am. I don't know who or what they've made of me, but that lunatic, that brute is gone. It's not me anymore—I mean, I'm not whoever that person was, and . . ." His face grew blank. "Put it that way, and it's not so bad. Better an identity crisis than the identity I had."

Parr's eyes had narrowed. "Listen to you. You're still crazy. They should never have let you out."

Josh blinked. "I won't say you're wrong." He looked vaguely at Mr. Parr. "I think I was wrong, wrong to come here. I won't do it again." He turned around and began to shuffle back up the street. "Guess it didn't matter."

"What? Son of—"

The blow fell hard on the side of Josh's head. He sprawled to the ground, half on the lawn, his cap falling free. A shadow moved over him.

"If you're going to say my daughter didn't matter, say it to my face! *Look at me!*"

Josh rolled over, to see John Parr looming over him, fists cocked. He tried to speak, to tell him he had misheard, but he was too stunned to get out a word. An awareness of neighbors beginning to gather on sidewalks or peer through doorways and windows strayed into his mind.

"Or maybe you'd like to come at me, hm? Someone bigger, ready to defend himself. Not so eager for that as for a helpless girl, huh?"

Josh felt the man's glare, felt the long scars on his scalp start to burn as if being heated by waves of hatred. Far in the distance, a siren wailed.

Josh began to pick himself up. That was Parr's cue to lunge.

Dr. Peale caught up with him at the hospital. His injuries were not serious enough to keep him there, and she drove him home. He didn't say a word, and she broke the silence only to call his parents, and someone else. Josh was



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more talkative once he was home, by degree, and out of necessity.

"I told you, I don't want to press charges."

Dinah touched his shoulder over the back of the chair. "Dear, I don't think it's going to be up to you."

"I provoked him. I'll swear to that."

Peale shook her head. "There were witnesses," she said to Josh's parents. "They'll have a different story. In your son's depressed condition, I think he believes himself deserving of any punishment he gets."

"So your treatment didn't work," Owen said.

Peale looked over to Dr. Dreher. "It's more correct to say it was incomplete," the white-haired lady said. "Schizophrenia correlates to some of the same defects in brain structure and chemistry as severe depression does. The frontal lobes and basal ganglia have lowered metabolism in both conditions. The overlay on Mr. Muntz rectified this, and also damped dopamine production in the left hemisphere."

"However," Peale said, "there are some areas implicated in depression that the overlay did not touch, and a few where erasing schizophrenic tendencies arguably strengthened depressive ones. Limbic system metabolism is low in schizophrenia, but high in depression, so when the overlay raised that metabolism, it may have made Josh more susceptible to depression. Also, there were signs of over-activity in the outer edge of the prefrontal lobe, which contributes to depression. Our pre-operative scans found this, but . . . we intentionally left this alone."

"What? Why?" his parents chorused almost perfectly. Josh's look of betrayed reproach hit Peale more closely.

"We need to be careful. Overlay treatments are still fairly new; our knowledge is incomplete. We perform only what's necessary. Also . . . if we're to take responsibility for releasing violent people back into society, we have to be certain they won't revert to violence. The prefrontal areas I mentioned are where long-term memories are seated."

She looked squarely at Josh. "Memories like yours of the attacks. If we erased those, we'd uproot the anchor for any remorse you'd feel over them, and lower your inhibitions against any surviving inclination to commit them again. It was a calculated compromise." She dropped her eyes. "I'm sorry that it's left you still unwell."

"And that's it?" Owen snapped. "You did your best, and we're stuck with the result?"

"No," said Dr. Dreher. "For one, I'll be taking over Mr. Muntz's therapy. My approach is more dynamic than Dr. Tranh's, which may be what Josh needs. Dr. Peale's team will run new scans to confirm our hypotheses about his brain structure."

"That won't do me much good," Josh said, "unless the surgeons—oh, no." He laid a hand to his temple.

"Actually," Peale said, "there's an alternative. We've made great strides lately with TMS—transcranial magnetic stimulation. It can alter neural pathways and chemistry without physical contact. Assuming the animal tests go well, we could start using it on human patients within three months. If you want, you're first on that list."

"More experimenting?" growled Owen, but Dinah's fierce look silenced him.

Josh nodded weakly. "But three months?"

"That's where I come in," Dr. Dreher said. "You'll find my hospital different from the state facility. Much less concentration on security, on sequestering people from society. Still, Luci and I agree it's an appropriate place for you now, to keep you safe."

Josh looked forlornly from one woman to the other. His parents were just visible in the corners of each eye. He closed those eyes, looking inward.

"I think I'd like that."



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* * *

"Well, there he goes," Mrs. Viselli said, as she rose and brushed dirt off her sleeves. "Can't say I'm sorry."

Elena jounced the baby in her arms as she watched. Two unfamiliar women walked on either side of Josh, while Dinah stood at the front door. The white car had "Oak Shade" printed in modest lettering on its side.

"Those same women were there last night," Mrs. Viselli added. "One of them's a brain-wiping scientist. The pretty one, on the right."

"What happened?" Elena asked. "He didn't—"

Mrs. Viselli's face soured. "He went harassing one of the families yesterday, and had some sort of breakdown. I don't think he attacked another girl. He sure didn't get the opportunity with the family: her father was there."

"Oh, good." The car revved up. "I guess we can get back to normal here now."

"Mm-hm. As good as normal gets around here, anyway." ■


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# UNSEEN

## Robert R. Chase

Sometimes good research subjects are closer than you think!

Dinnertime at the Graduate Center was the occasion for critiquing professors, presentations, and entire curricula. Students in the English department bemoaned instructors whose distaste for their subject was so great that class time was devoted to deconstructing it rather than teaching it. Law students gave cynical applause to professors able to contort 14th-amendment due process to mandate whatever was the politically correct cause of the month.

This evening it was Julie Henderson's turn. Julie had sharp facial features, which, to Rick Warner, suggested a picture of a gremlin he had seen long ago. Her mother had set her dark hair in its present style when Julie was ten years old. Annoyed eyes of indeterminate color peered out at the world from dark-rimmed glasses.

"When I was growing up in Colorado, I used to camp out on the mesas. At night, I would look up at the sky and marvel at its silent brilliance. It seemed to me that nothing could be more desirable than to work in an observatory and peer deeper into the night. I read the popular books, and astronomy seemed to be a wonderful puzzle that was on the verge of being completed."

"And now?" Rick asked, around a mouthful of overcooked peas.

Huge sigh. "And now the puzzle has been blown to hell and nobody knows anything."

"Surely it's not as bad as that," Rick said, trying to sound sympathetic. *And if it were, I can't imagine any department chair admitting it.*

Impatiently, Julie grabbed a napkin and drew a circle. "This is the Universe. Everything."

"Um." The meatloaf was tasteless. Which, given the past performance of the university cafeteria, was on the whole a good thing.

"Now this radius represents the proportion of heavy elements in the Universe. The stuff that you and I and the planets are mostly made up of. Maybe three hundredths of a percent of the whole. This little slice is the stars: half a percent. Free hydrogen and helium make up a whopping 4 percent of everything."

Rick frowned, aware that he must be missing something. "So what about the other, uh, 95 percent?"

"This part," Julie said, outlining a large segment of the pie, "is thought to be



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dark matter. And this segment, nearly two thirds of everything that is, is, maybe, dark energy."

The napkin tore as she tried to color in the dark energy section, but the pen continued back and forth until the napkin was completely shredded.

"I know I've been narrowly focused of late," Rick said. It was part of a standing joke among the graduate student population. When the Twin Towers had fallen, few students had shown any interest in either protesting or enlisting. The most common question had been "Will this change the date for midterms?"

"However, would you please explain, in words that a biologist can understand, what dark matter and dark energy are?"

Julie's cackle would have done the witch in Snow White proud. Students at three of the other tables turned to regard her for a few seconds before turning back to their own conversations.

"Nobody knows! Nobody has any idea. Or rather there are all sorts of ideas, most of which are closer to metaphysics and theology than to anything I can recognize as science. We're all scrambling around like Chicken Little because we are having our noses rubbed in the fact that we know at most 5 percent of what is going on."

"Gee, Julie, that's too bad," Larry Reed said, setting his tray down next to her. At the age of twelve, Larry had been ravished when he stumbled across a copy of Shelley's "Ode to the West Wind." He was now going for his Master's in English Literature. Since discovering that his advisor knew everything about Derrida and Foucault and nothing about Keats or Byron, he had wandered about the university with a perpetually wounded expression. "I guess you have it even worse than the rest of us."

He glanced at Rick as if daring him to top Julie's tale of woe.

Rick shook his head. "All I have are my jellies. *Nausithoe* and *Phronima*, *Cunina* and *Arctapodema*. And myriad of their microscopically small cousins."

"What do they do?" Julie asked. Her tone of voice indicated that the question was merely an effort to be polite.

"Die, mostly. I'm trying to get some ideas about predator-prey strategies used by transparent animals—"

"Transparent?" Earl Duncan asked. A second-year law student, he usually wore a sleepy expression that was equal parts boredom and exhaustion from weekend carousing. Now, for the first time in Rick's memory, he looked fully awake.

"They are called transparent," Rick explained patiently, "but they really aren't. Translucent would be more accurate. Anyway, they're not living long enough for me to do anything with them. If I can't do any better at keeping them alive, I may have to choose another thesis topic."

The lab where Rick worked was a combination of utilitarian starkness and apparent disorder that would have been familiar to almost anyone who had ever worked in any lab anywhere. Rick hardly noticed the clutter as he made his way over to the corner which the department had, somewhat grudgingly, set aside for his work.

He was intercepted by his undergraduate assistant, Arthur Santorini, as he stepped in the door. With his can-opener nose and shock of red hair, Arthur bore an uncanny resemblance to Disney's Gyro Gearloose.

"Rick, I've solved our problem."

"Great. So you've found a way to keep our jellies alive?"

Arthur frowned at him as if he had changed the subject. "Well, not exactly, but I've discovered what's eating them."

"Uh, good," Rick said, somewhat dubiously. "What's the story?"

"You remember you were thinking that the *Arctapodema* might be succumbing to a virus?"

Rick nodded. It had been a stray thought, born of desperation more than anything else. There were uncounted



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numbers of viruses in seawater, but beyond that, astonishingly little was known about them. He certainly had no idea which one might attack different species of jellies so ferociously that they seemed to disintegrate before his eyes.

"So I thought it would be worthwhile examining some with the electron microscope Kuiper let us use."

"That old thing?" Rick asked. "Nobody uses that technology any more. Kuiper was told to donate it to the Smithsonian, but he's been too lazy to do any of the paperwork."

"Right. So I dried out the samples—"

It was always the most dangerous part of the procedure, to dry out samples in such a way as to prevent shriveling. When dealing with sample creatures like *Arctapodema* which were more than 90 percent water, it was an exponentially more difficult task.

"—then I put it in the sputter coater to add the gold layer that would make it conductive. Only before that, I took a five-power picture for comparison purposes."

Arthur handed it to Rick. It looked depressingly familiar. A healthy *Artapodema* had a classic medusa shape, much like the dome in which he played tennis during the winter. The right half of this one had fallen apart. Translucent shreds were floating away as they broke into smaller pieces themselves.

"And when you put the sample into the vacuum column?"

"I never put it in there." Arthur's face was split by a maniacal grin, as if he had performed a particularly spectacular magic trick and was daring Rick to guess the explanation.

*Patience*, Rick counseled himself. "And why didn't you put it in the vacuum column?" he asked, since that was clearly expected of him.

"Because this is what I saw when I took the sample from the sputter coater." With a flourish, Arthur produced the vacuum-sealed sample. Rick examined it for a minute, frowning.

"This isn't the same thing. This *Arctapodema* is being eaten by this—well, I don't know what it is."

"Here is photo of that sample blown up to the same size as the photomicrograph I just gave you," Arthur said. "Compare the two."

Rick rotated them until their alignments matched. There were slight differences, most of which could be accounted for by the span of time between the photos—except for the thing on the left side of the electron microscope sample which was busy devouring the jelly.

"Why don't I see this in the visible light version?"

"Because it's *invisible*!" Arthur said triumphantly.

"That can't be . . ." His voice trailed off. Earlier, he had referred to the creatures he was studying as transparent animals. It was the common term. But as he had corrected himself, they were merely translucent, although size and lighting conditions might make them very difficult to spot underwater.

This creature, however, was transparent in good light in a sample dish.

"How many of our specimens are left?" he asked suddenly.

"About half."

"Then let's get to work."

There were enough for fifteen more samples. Eight of them showed nothing unusual. Seven displayed the shredding Rick was already beginning to think was characteristic of attack by invisibles. After coating, each of the attackers was revealed. Surprisingly, each of the attackers was different enough to be a different species. Even more surprising, three of them appeared to have hard body parts.

"This one looks like a roach, doesn't it?" Arthur said. "I wonder how it makes its shell transparent?"

"I have no idea," Rick admitted. He sat back and glanced up at the clock. Somehow the entire day had disappeared. A rumbling in his stomach indicated that



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he had forgotten lunch. "But I think my thesis subject has just changed. In fact, I should go see Starzinger now before his office hours end."

Chunky in build, with a flat-top hair cut and what appeared to be permanent five-o'clock shadow, Vlad Starzinger looked more like a former Marine sergeant with a taste for good suits than the general image of a university professor. Rick found him more than a little intimidating. Sitting across from him, Rick wondered if Starzinger might consider the whole thing a prank and throw him out of the office.

"You are going to present this at Johns Hopkins next week," Starzinger said without preamble.

Rick blinked, momentarily at a loss for words. "I'm not sure I can get this ready in time. Besides, papers for that conference were due a month and a half ago."

Starzinger waved his objections away impatiently. "I know the organizers. They've been upset for two years about how all the really interesting stuff gets posted on the Web first. Makes it hard to convince certain penurious departments to put up the travel money to send many people to these conferences. This is just the sort of thing they need to counter that kind of thinking.

"As for getting this ready, I have every confidence that you will be able to give a talk that will do the university proud."

He was still wondering how he was going to do that as he walked back to his apartment. He had been very lucky to find a place he could afford within three blocks of the university. The landlady, Mrs. Rosenblume, had been unusually apologetic as she showed it.

"It's a basement apartment," she told him. "Probably not what you want if you're an art major or anything like that."

Rick assured her that he was a biology student and so would not need access to natural lighting. "Is there much crime in the neighborhood?"

"Enough that I barred the lower windows," she said glumly.

There was a bedroom, a full bathroom, a living room, and a kitchenette. Speakers adorned the walls of each room.

"They belonged to the previous tenant, a music major," Mrs. Rosenblume explained. "Spent most of his time wiring the apartment. Didn't have enough money left over to pay the rent."

Each room had as well an oscillating fan on the floor, pointing in the general direction of the door. A combination night-light and air freshener was plugged into the wall socket in front of every fan. Odors of rose, cinnamon, and vanilla assailed his nose as he walked from room to room. The effect was sometimes disconcerting where they mixed.

"I'll unplug those," Rick said. "I don't need the lights and I would just as soon open the windows for fresh air."

"I would advise against that," Mrs. Rosenblume said.

"Why?" he asked, when it was clear she was going no farther on her own.

There was a fateful pause, followed by a sigh so long and so profound that Rick half-feared she would collapse into herself.

"Here's the whole story," she said in a tone of voice that would have been appropriate to confessing theft of poor-box funds. "This is an old part of town, y'know? The sewer system must have been constructed nearly a hundred years ago. So there's basically one system with two levels, the top level for rain water and the bottom level for the, uh, rest.

"So last year, a hurricane comes up the coast. It breaks up by the time it gets up here, but there's still plenty of rain. There are flash floods all over town. Everything comes up from the sewers. I mean *everything*. The water goes down and there's muck three inches thick over



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the entire basement. Don't try to imagine the stench. It's impossible.

"There's some help from the city and from some neighbors. We shovel and mop for two days, but that's just the beginning. I put fans down here, more and bigger than what you see, to dry things out. I have the carpeting ripped up and new put down. Get my son-in-law to repaint the wallboard. Everything looks great.

"Only, there's still a smell. No amount of scrubbing, no amount of Clorox can get rid of it." That put a name to an odor that he could barely perceive: chlorine bleach. For the first time, he was thankful that his sense of smell was relatively weak. "City inspectors come by and certify that nothing's, y'know, unsanitary, but they can smell it too.

"Only thing I can do is try to circulate the air so it doesn't get stagnant and mask any smell with air fresheners."

Rick thought about it. "So what's the rent?

Almost fearfully, she named a figure.

"Where do I sign?" he demanded.

He had tried removing the air fresheners from the walls and opening the windows, but that allowed the smell of liver and onions to drift down from Mrs. Rosenblume's kitchen. Rick wondered if lack of funds had been the real or only reason for the departure of the previous tenant.

It had taken him a week to realize that Mrs. Rosenblume had not been completely forthcoming after all. The entry to his basement apartment was through the front door hallway. A short flight of steps to the right led downstairs. A similar set of stairs to the left led up to the rest of the house. It was his only entrance. When the potential importance of that struck home, he had checked the fire extinguisher at the base of the stairs, only to find it inoperable. Mrs. Rosenblume promised to have it recharged or replaced.

For now, though, however checkered its past, however flagrant its current fire code violations, it was home. He had fixed up the old speaker system which now played Brian Setzer to clear the fog from his brain in the morning and Fauré to relax him at night. Makeshift bookcases of cinder block and plywood groaned under the weight (even in these days of floppy disks and CDs and the internet) of biology texts. The top shelf was reserved for leisure reading: short stories, poetry and essays, mostly for the simple reason that his studies left no time for anything longer. Kipling and Browning, Eliot and Auden, and an occasional modern like James Fenton, thrown in at Larry Reed's suggestion. Stories by Saki and Kipling (again), Chesterton and Ellison, Davidson and Sturgeon. Essays by George Orwell and *Rants* by Dennis Miller.

He turned on the radio to the university station and made himself an omelet while the city wound down around him. After cleaning up, he pulled down a volume and opened it at random to Poe's "City in the Sea."

He fell asleep almost immediately. In a dream, he stood in a crumbling tower in the midst of a gray, choppy sea. There were things in the water and in the darkness behind him. Some were translucent like the specimens he had been studying, but much bigger. Others were completely invisible. He could not tell if they were menacing.

He woke up at two in the morning. After stretching to get some kinks out of his neck, he shuffled around the apartment to shut the lights out before falling into bed.

The good thing about not having enough time to prepare for the presentation was that there was no time to get nervous. When he saw the basement room in one of Johns Hopkins' older buildings which had been provided to him, Rick felt simultaneously relieved and disappointed.

"At least there won't be that many



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people around if I screw up."

"Don't believe that for an instant," Starzinger said, resplendent in a thousand-dollar suit and gold collar pin. "That I've shoe-horned you in at the last minute has generated plenty of interest. The fact that the room will be entirely too small for the crowd will just add to the story later."

And, indeed, the room was filled to overflowing. There were at least a dozen people standing in the aisles. Curious faces peered in through the doorways. The room was sweltering even before Rick began to speak. Two huge fans had been placed in opposite corners at the front of the hall. They oscillated noisily, like disapproving aunts. Pointed away from Rick, they did nothing to disturb the sweat breaking out on his brow.

"Good afternoon. I am delighted to see so many of you here, especially on such short notice. Before I begin, I would like to acknowledge my indebtedness to my advisor, Vlad Starzinger, and to Sven Johensen, whose work was recommended to me by Professor Starzinger. When I started these investigations, I had no idea I would end up with what I am about to show you. It's rather warm in here, so I'll show you what I have as quickly as possible."

Arthur operated the laptop for the PowerPoint presentation, leaving Rick free to concentrate on the spoken portion. They had jointly decided to keep it simple. Explain how the pictures were taken, the precautions instituted to ensure that the pictures of the visible light samples matched those taken with the electron microscope. Explain in detail the lighting provided for the visible samples. Offer no firm conclusions, keep all speculation for the end, and even then, keep it to the minimum.

". . . and so, you see, all we have been able to do is to raise a series of questions to which we have no answers. Just yesterday we discovered that if you dissect this specimen" (the one that looked like a roach flashed on the screen) "it completely loses its transparency. Why? Others, which we have been able to bring to partial visibility by suspending fine particulates in solution so that we can perform a dissection, don't show this property at all.

"All of this only begins to hint at the extent of our ignorance. Although we haven't started on taxonomy, we have learned that invisibility has been invented independently by apparently unrelated species. Even as flight has been invented by creatures as diverse as mosquitoes, birds, and bats, and bipedalism by dinosaurs, kangaroos and primates, so invisibility seems to be one of those solutions favored by evolution for diverse species. We have made visible creatures which at least look like jellies, arthropods, and mollusks. This suggests that there is much work to be done and many papers yet to be written.

"Now, I will be happy to try to answer any questions you may have."

The first few questions dealt with minor details: Could you provide more details on how the specimens were prepared? Precisely where in the Atlantic were these samples collected? Had invisibles been found in any fresh-water samples?

The body language of the fourth questioner announced that he was trouble even before he began to speak. "Can you explain why you have wasted our time with this charade? How can you expect us to take seriously something which is theoretically impossible and for which you have no explanation?"

Rick felt his face heating. Momentarily at a loss for words, he glanced down at the front row, where Starzinger was gazing impassively up at him. *Just waiting to see if I can handle this.*

He took a deep breath. "I assure you, Mr.— "

"*Dr.* Tannenbaum!"

Rick was speaking with a tremor. He licked his lips, determined to get control of his voice. "I assure you, Dr. Tannenbaum, that for purely selfish reasons I



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would not endanger my career at this early stage with any sort of charade or prank. There is always the possibility of experimental error, of course, but Professor Starzinger has checked our work very carefully and I am sure I need remind no one of the quality of the work he has done during the course of his career. In any event, we will provide our samples to other laboratories and we will then see if our results are duplicated."

There was a minuscule nod from Starzinger. It was a decent answer. He could, probably should, leave it at that.

"I must also question your emphasis on theory. Theory is important, without doubt. Yet in their day, phlogiston and the Ptolemaic view of the Universe were as respectable as they later turned out to be wrong. That is because theory is merely a human creation to make sense of our perceptions of reality. It is, if I may be forgiven for using the G-word, God's reality which is primary. Our job as scientists is to make our theories conform to that reality rather than the other way around."

There was a smattering of applause. Tannenbaum flushed, but showed no sign of giving up.

"Still, if your observations are valid, why has no one ever seen them before?"

Arthur and Rick spoke simultaneously. "Because they're invisible." "Because no one has ever looked in the right way."

A wave of spontaneous laughter swept through the hall. "Glib answers to a serious question," Tannenbaum said sharply.

Rick held up a hand, trying to restore order in the hall and, if possible, make peace with Tannenbaum. "But honest answers for all that. Look, when I was a youngster, nobody looked for lifeforms in hot springs or pools with high salinity or metal content because everyone knew nothing could live under such conditions. Now we have realized that those may have been the conditions necessary for the origin of life, that as much as 90 percent of the Earth's biomass may still be accounted for by such extremophiles.

"Think of it! Ninety percent, and the scientific community had not the slightest clue that any of these things existed because nobody looked. Well, we have looked. Not because we were smarter than anyone else. We just blundered into this, and Arthur was smart enough to realize what it was we had blundered into. Having looked, and having found the means to make the unseen visible, we have uncovered something new. I have no doubt that those of you who follow up on our research will find that we have merely scratched the surface."

More general applause. Tannenbaum sat down, still frowning. The afternoon presentation soon ended on an upbeat note.

Rick's elation lasted until he checked his e-mail three days later.

I AM ASTONISHED AND APPALLED THAT YOU CHOSE TO ASSOCIATE ME WITH YOUR POORLY RESEARCHED AND ILLOGICALLY STRUCTURED PRESENTATION. I HAVE SPENT TOO LONG DEVOTED TO THE STUDY OF THE MANY TRANSLUCENT MARINE ORGANISMS FOR MY LIFE'S WORK TO BE SUBJECT TO RIDICULE FOR ITS ASSOCIATION WITH SCIENCE FICTIONAL CREATURES OF YOUR IMAGINATION. NEXT YOU WILL RAISE AN ALARM THAT WE ARE THREATENED BY CREATURES OF HUMAN SIZE OR GREATER.

MY REQUEST IS THAT YOU ABANDON THIS LINE OF RESEARCH AND FIND WORK MORE IN ACCORD WITH WHAT TALENT YOU MAY HAVE. I AM ASKING YOUR ADVISOR TO IMMEDIATELY TERMINATE HIS INVOLVEMENT WITH THIS EFFORT.

The message was from Johensens@whoi.edu.

"Oh crap!" Arthur had been reading the screen over his shoulder. "What are you going to do?"

"I'm going to—"

The phone rang. Rick's eyes widened as he saw the number on the caller ID. Only then did he note the other address on the e-mail's copy furnished line. "I'm going to talk to my advisor right now."



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Starzinger was glaring at a piece of paper as Rick entered his office. "I'm awfully sorry about this—" Rick began.

Starzinger waved away his apology. "Nobody has the right to ream out my students this way. Except me."

"What should we do, then?"

Starzinger scraped a match across his desk and lit an expensive cigar, taking more obvious delight in flouting the university's no-smoking policy than in the smell of the tobacco.

"You will take a seat there. I will make a telephone call."

Rick felt behind himself, found a chair, and dropped into it. Starzinger jabbed at the telephone keypad with blunt, hairy fingers.

"Sven. Vlad Starzinger. Glad you liked the Jack Daniels. It was for sipping on your birthday, not for guzzling all at once. You don't? Let me read you something I just received." He read the e-mail. "It's signed Sven Johensen. Point of origin is Johensens@whoi.edu. Yeah, I know that's your address. Sent at 6:50 this morning. You didn't get in until eight? Well, does someone have your password? Any hackers up there having fun?"

Starzinger was silent, nodding and grunting occasionally as he listened. A sudden thought occurred to Rick. He leaned forward, mouthing "Tannenbaum."

"Well, I think you would find it a very interesting piece of work. I'll send you a copy of the boy's presentation. Look, do you know anybody named Tannenbaum? He was at the presentation and pitched a fit. Hmm? Okay, then. I'll keep in touch."

He cradled the phone with an air of great satisfaction. "This is totally bogus," he said, picking up the e-mail message and shaking it at Rick. "Sven knows nothing about your research, though he does say it sounds interesting. He did not send you this message, though it appears it did come through his account. He has no idea how. He doesn't know any Tannenbaum."

"So what do we do now?" Rick asked.

Starzinger pointed the cigar at him. "You go back to work."

The trustees had seriously considered razing the library and selling the land to the city for low-cost housing only two years before. After all, paper books and magazines were considered an anachronism in the computer age; all search materials could be found more easily over the internet. Moreover, there was something positively anti-progressive about the permanency of books that served to perpetuate the errors of the past. Most important, upkeep and maintenance was a considerable drain on the budget. It would be no more than responsible stewardship to turn this yearly expense into a cash cow.

Surprisingly enough, it was student protest that killed the idea. For at least some—generally the pre-meds and engineers, but also occasional students like Larry Reed who were actually interested in their courses—there was need for a place of quiet where they could study without having a drunken roommate vomit all over their keyboards or having their notes vibrated off their desks by 200 decibels of alleged music coming through the walls from the next room.

(Resorting to self-help by, say, yelling at the water buffaloes to keep it down, was officially frowned upon as being at least insensitive and quite possibly racist.)

The administration was irritated to have these points brought to its attention and would have totally ignored them save for the growing public reaction outside the campus, particularly among several old and well-heeled alumni reactionary enough to side with the students. So the library was saved and the administration publicized the decision as evidence of its commitment to higher learning, respect for tradition, and sensitivity to the wishes of the student body.



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This particular afternoon found Rick at one of the long library tables staring out one of the tall windows. Dust motes danced slowly in the slanting sunlight. The worn carpeting showed indentations where chairs had stood for too long. Although Rick's laptop was open, he had not touched a key in a quarter of an hour.

"You are taking this all wrong." Earl Duncan frowned. "A self-important twit tried to embarrass you during your presentation and you took him down. Then some moron plays games with e-mail. Your advisor stands by you and as a result, one of the major figures in your field becomes aware of your work for the first time and looks like he will become a supporter. That's two for two. So what is the problem?"

"It's . . . I dunno," Rick said. "I just never thought my research would be this controversial. Arthur spotted a supermarket tabloid that's got hold of the story and is headlining that we are all threatened by invisible monsters. It's impossible, but they will never realize that."

"Why do you say it's impossible?" Julie asked. "I saw a note the other day that some people at Austin have found how to make skin transparent by injecting glycerol."

"Small pieces of skin," Rick said. "Not an entire organism. You can't make bone invisible. Without bone, your monster is going to be pretty helpless."

"Not necessarily," Earl Duncan said. Earl had entered law school because he loved argumentation. He loved it so much that if someone agreed with him too quickly, he had been known to switch sides merely to prolong the discussion. "Tubes of air at high pressure could take the place of bones. Nothing's more transparent than air."

The glowing dust motes threw themselves into storm gusts when anyone passed. Yet sometimes they stirred in odd ways when no one was near. Breezes from the ventilation ducts?

Reluctantly, he forced himself to focus on the topic. "Okay. Let us suppose that we could have a creature of appreciable size—"

"Appreciable size being?" Earl asked.

"Being something that stands anywhere from knee-high to head-high. And it manages to be not merely very well camouflaged, but truly invisible—"

"Organic optical fibers," Julie suggested. "A sheath of them which conduct light 180 degrees around the creature. I think that is the reason that one specimen of yours became completely visible once it was opened."

Rick stared at her, trying to digest this new information while maintaining his train of thought. "Whatever. But if it is truly invisible, it must be blind as well. So now it's lurching and stumbling around helplessly—"

"Even I know better than that," Earl said. "Every high school lab I was ever in had a poster of the electromagnetic spectrum with the visible portion as narrow as blue-nose's mind. Your creature could have excellent infrared or ultraviolet vision and still be invisible to us."

"Or it could find its way around based on sound or scent," Julie added.

"Enough already." Rick held up his hands for peace. "Can I at least get you to agree that this creature would have to eat and drink?"

"And we don't see food being digested in mid-air," Julie said, nodding quickly. "But if my sheath of organic optical fibers is correct, you wouldn't."

"And can we stipulate that these creatures die from time to time?"

"Fair enough," Earl agreed.

"So, if our creature is a herbivore, why don't we ever see grass being chomped down to the ground? Why don't we see fronds being broken off and hovering for a few seconds before they disappear? For that matter, how come nobody ever trips over an invisible corpse?

"We don't see the wind, or ultraviolet radiation, or *e. coli* bacteria, but we



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know about all of them because we interact with them whether we like it or not. We can stop wasting our time discussing these hypothetical creatures because there are no such interactions."

Rick glared around the table, as if daring anyone to contradict him.

"But we have had interactions," Larry Reed said. "At least, there are stories."

Larry had been so quiet for so long that Rick had forgotten he was there. "What stories?"

"Remember that DeMaupaussant story I recommended to you, 'The Horla?'"

"You recommended it to me as fiction," Rick said testily. "A story. Written by a guy going crazy with syphilis. About someone terrorized by an invisible creature that never does anything more frightening than lap up milk and water. Oh the horror!"

"You are being unfair," Earl said. Larry looked at him with gratitude. "There have always been stories about invisible creatures living with or near people. Didn't peasants put out saucers of milk for brownies or the Fair Folk?"

"And if you wanted to keep people away from your shelter," Julie said, "what better strategy than to take over an abandoned dwelling and make any folks who come by believe that it's haunted?"

Rick turned away, angry that he was letting himself be baited for their amusement. Looking out the window, he saw the shimmer of heat rising into the outside air.

Only the window was closed and the heat was not on.

His chair tipped over as he stood and lunged around the side of the table toward the window. There was, perhaps, the slight stirring of an errant breeze.

"What?" Julie asked. She was standing. They were all on their feet, staring at him.

"I . . ." His waving hands encountered only air. Looking down, he could no longer spot the indentations in the carpet he had assumed had been made by chairs. The building creaked. But it was old. It always did that.

". . . don't know."

The work continued and was taken up by other researchers. Invisibility was moving up to the macro world. An informal competition had grown up among the researchers as to which group could identify the largest invisible creature. Stanford held the record currently with a five-centimeter starfish found near the black smokers of the mid-Atlantic Ridge.

Rick published two papers and was pleased to see them in a growing list of citations. His work was mentioned in a *Scientific American* column and became a cover story in *Discover*. A few of his colleagues, for whom popular meant vulgar and vulgar meant unscientific, frowned and muttered.

Most of the scientific community, however, had swung firmly over to his side. Invisible creatures were even losing their novelty. What had been heresy had almost completed the journey to becoming something we had basically known all along. Still, Rick found himself remembering Julie's comments from months before. The Universe that we see is only 5 percent of what is there. Everything else is dark, a mystery.

It appeared that one of Julie's guesses had paid off. At least some of their invisibles were indeed wrapped in sheaths of organic optical fibers. The university formed a consortium with several telecommunications companies to explore ways of growing such fibers. Julie abruptly moved from astronomy to physics and was doing work funded by DARPA.

"What sort of work?" Earl asked.

She smiled at him. "Can't tell you."

"That's what I thought," Earl said.

If at times Rick appeared distracted, as if straining to hear an inaudible conversation, his friends attributed it to the press of work. Most of them knew that he tried to get an early morning run in



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four times a week. None of them knew that he had stopped washing his sweats and was just hanging them in his hallway near one of the fans.

He spent time with the sound system that had been left in his apartment by its previous music major occupant. It had a turntable, two cassette players, a CD player and burner. There were jacks and plugs for the primary speakers, the auxiliary speakers, and what seemed to be an auxiliary auxiliary set. There were switches set up to control each speaker individually or in preset groups.

One evening Mrs. Rosenblume came down with a plate of brownies and surprised him while he was fiddling with the equipment. His guilty start made her smile.

"Karaoke," she said, nodding, and left without another word. Rick considered it and decided that was as good a story as any.

There was a dead doe outside his apartment the next morning when he came back from his run the next morning. It had to have died within the preceding forty-five minutes. Astonishingly, there was a city clean-up crew already on the scene.

"Guy who ran into it called us on a cell-phone," one of the workers said, in response to Rick's question. "Member of Greenpeace, he was all broken up. Car was in bad shape, too."

"How did it get this far into the city?" Rick asked.

"They're coming in further every year. With most of their natural predators gone, the herds have undergone a population explosion. At the same time, all those new housing developments have really diminished their natural habitat. So more and more they come into built-up areas just looking for food. And lots of the time this is what happens.

"Funny thing is, the driver spotted the doe and had slowed, but when he was almost past, it spooked and jumped right out in front of him."

* * *

"I'm going to visit my sister in Cincinnati," Mrs. Rosenblume said that night. "I'd like you to look after the place while I'm gone."

"Sure, but I'm working kind of odd hours. What do I need to do?"

"Just make the place look occupied. I have lights on timers but it's better to have people around. Maybe you'd like to have your friends over for a party. That'd be fine."

She had always complained about the parties and loud music of the previous tenants. "Are we concerned about anything?"

Mrs. Rosenblume looked uncomfortable. "I dunno. Dogs have been howling the last few nights. I heard something outside my window last night."

Rick thought for a moment. "The garbage cans are on that side of the building. I bet you heard a raccoon." He recounted what the city worker had said about encroaching wildlife, and was astonished to learn she had not known about the dead deer. "That would explain what set the dogs off."

"Mebbe." Mrs. Rosenblume shook her head doubtfully. "On th'other hand, it could be some cokehead trying to break in and steal enough money for his next hit. There've been more robberies in this part of the city lately. Not everything that happens gets into the papers. I'll rest a lot better if I know you're looking after things."

"I'll take care of everything," Rick assured her. "Think no more about it."

Whether she did or not, he had put everything out of his mind in less than fifteen minutes.

He woke up. The clock dial glared at him: 2:35.

*Why am I awake?*

There was the white noise of the fans, so constant as to be effectively inaudible most of the time. Dogs had been howling earlier. Big deal. Live in the city and you learn to sleep through a large amount of ambient noise.


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He was rigid, scarcely daring to breathe. He was listening intently for something, but he did not know what.

The ceiling creaked. Once, pause, and then three more times in rapid succession. A heavy tread followed by three lighter ones.

He swung his feet to the floor and reached for the phone. Again, the oddly-rhythmed creaking from the ceiling. As if someone were searching for something.

He didn't lift the phone from its cradle. What would he tell the police? I don't know what it is, but I'm pretty sure it's invisible? What could they do if they came?

They could frighten it away. He didn't *want* it frightened.

He stood up and moved silently to the kitchen. There was a cereal bowl in the drainer. He half-filled it with water.

In the near silence, the pipes made a sound like a loud, indrawn breath. The noises above him ceased abruptly. Then, a quick scuttling, toward the landing. Toward his door.

Rick's door was at the end of a hallway. It had its own lock. He stood in darkness seemingly made more intense by the night-light air freshener plugged into the wall, wondering if he had the courage to walk to the end of the short hallway and unlock the door.

The door seemed to bow, as if being subjected to strong, steady pressure. There was a popping sound and the door swung open. A gust of wind blew leaves into the hallway. A siren, sounding very far away, echoed off the brick and stone faces of the buildings.

Rick waited at the other end of the short hallway, listening for any sound, looking for anything that might indicate movement. After a minute, he started to wonder if the door had just failed to latch and been blown open by the wind. It was an old house. You had to close the door carefully and then jiggle it to work the lock.

His sweat-suit hung from a peg on the hallway wall. The sweat pants began to jerk and sway, as if being poked. The sound center remote was in his hand. He must have picked it up without realizing it. He lit the buttons and keyed in the first track.

"Welcome. I was wondering if you might visit me."

His voice came from the speaker near the open door. The sweat pants became still.

So you broke in and navigated, at least in part, by smell. Now you hear my voice and it confuses you. It's dark, so unless you can see in the infrared, you shouldn't have much of an advantage over me. Now, have I just spooked you into retreating?

The nightlight in the hallway wavered. It was approaching. Moving as quietly as possible, Rick stepped back through the kitchen to his bedroom.

"I guess it must have been a surprise when you realized you were about to be discovered." Now his voice came from both hallway and kitchen speakers. "You have been able to hide successfully for thousands of years. Was there some sort of grand council where your people decided fighting humanity would be a losing proposition? Or are you just naturally non-confrontational?"

*I would really like to believe the latter. Especially since I have just backed into a room with no exits and bars across the windows.*

"Either way, you decided that safety lay in keeping humanity ignorant of your existence. That has worked well. But then, somehow, you learned about my work. You realized that my investigations, and those of my colleagues, would lead us to you. In desperation, you tried to discourage me with that bogus message that was supposed to be from Sven Johensen. That might have worked, if my advisor hadn't seen through it."

The words were now bouncing from speaker to speaker. That should confuse the creature, slow it down long enough



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for him to make his case.

"Maybe when you sent that message, you didn't even know who or where I was. If not, you soon found me at the university. I think you were trying to find out how close I was to deducing your existence. And maybe you wanted to get some idea of how I would react, how humanity in general would react, once we knew about you. It must have been even more of a shock when we were in the library and you heard my friends outlining how you could find your way around while invisible and speculated on your past relationship with humanity. And then I nearly caught you, which must have reinforced all your worst fears."

In the small kitchenette, a chair moved an inch. Then the table. It was moving circuitously in the direction of the bedroom, even though Rick's voice was now coming from behind it, near the entryway.

*Smart little bugger. You've figured out that the speakers are just a distraction, so you are ignoring them.*

The phone was on the nightstand behind him, but it was too late to call for help. It was a relief, really. In the next few minutes something would happen, wonderful or horrible, and either way, it wouldn't go bad because he had wimped out. He shut off the speakers.

"Then you traced me here." His voice was hoarse and quavered through quarter tones. "That was very brave. The city must be tremendously dangerous to your kind. Crowds of people jostling on the sidewalks, cars and trucks rushing along the streets. What happened to the deer you spooked could just as easily have happened to you.

"So here we are, and you have to make an important decision. Are our species going to be friends or enemies? You have infiltrated our society thoroughly enough to learn our language and manipulate our computers. If you've been watching horror movies, you may have concluded that conflict is inevitable. You can make that a self-fulfilling prophecy. Even if you . . . silence . . . me, someone else will discover you. It's only a matter of time. And then my death will be re-examined and suspicion will focus on your people.

"Or you can remember an older relationship. You can remember the housewives who would put out bowls of milk and water so that your people would guard the house, or even perform small chores. I'm not saying this will be easy. You must know us well enough that you know how rotten we can be to our own. But maybe you've noticed that we are, ever so slowly, getting better in that regard. And maybe you've seen the way we can tie ourselves in knots to preserve rare species of no practical use to anyone.

"We have made alliances with other species in the past to their benefit. Your intelligence will add a new wrinkle to something that actually comes naturally to us.

"It's all up to you."

There had been no other sound while he talked. His hand trembling, he lifted the bowl of water off the table and placed it at his feet. He straightened slowly, feeling horribly exposed.

A sound of movement. Rick tensed involuntarily for the impact.

The water in the bowl was suddenly agitated. There was a sound of lapping.

Moving very slowly, Rick lowered his hand, wondering what it would feel, wondering if this invisible liked to be scratched behind the ears. ■

Everyone is quick to blame the alien.

—Aeschylus



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## THE ALTERNATE VIEW John G. Cramer

# THE UNIVERSE AS SEEN BY WMAP

This column is about the beginning of a new era of what is being called *precision cosmology*. It used to be a joke in the physics community that astrophysicists put the error bars in the exponent. In other words, they use numbers so poorly determined that they are unknown by several orders of magnitude. Well, as I predicted in a column eight years ago (*Analog*, August 1995), those days in astrophysics have definitely come to an end. As we will describe below, the Wilkinson Microwave Anisotropy Probe (WMAP) satellite, a joint initiative of Princeton University and NASA's Goddard Spaceflight Center, in its first year of operation has nailed down most of the constants of our universe to an accuracy of a few percent.

Let me start by summarizing the inflationary Big Bang model, today's standard paradigm for the history and future of the Universe. According to this scenario, the Universe began as a state of near-infinite temperature and energy density, a "singularity" in which the laws of physics are unknown. Almost immediately, it began a process of accelerated superluminal expansion that cosmologists call "inflation." Inflation smoothed out any energy lumpiness and flattened any curvature or space warping, leaving the Universe with only tiny variations in the energy density. These variations ultimately became the complex structures, stars, galaxies, galactic clusters, great voids, etc., that we see today. To form these structures, the gravitational pull of "dark matter" as well as ordinary matter was absolutely essential. But in addition to the normal and dark matter, a sizable part of the initial energy in the Universe ended up in another form that we call "dark energy." This is the energy contained in space itself, and, as we have discussed in previous columns (*Analog*, May 1999), it creates a negative "antigravity" pressure that pushes the Universe to expand at an ever-increasing rate.

After the initial Big Bang, after inflation was over and had been replaced by continued but slower expansion, the Universe was cooling down. The amorphous mass-energy of the early Universe resolved itself into particles—mainly photons, protons, electrons, and neutrinos. By some process that remains obscure, a slight excess of protons and electrons over their antimatter equivalents (antiprotons and positrons) had earlier been created. In the high-density early stages of the Universe, essentially all of the antimatter had paired off with its matter counterpart and annihilated, leaving behind the slight surplus of matter particles as "the only game in town."

About 400,000 years later, when the temperature had dropped to a few thousand degrees K, the negative electrons and positive protons began pairing off to form neutral hydrogen atoms. Free charged particles, which easily absorb photons, were then replaced by light-transparent neutral atoms, so that the "fluid" of the Universe was changing from murky black to crystal clear. The


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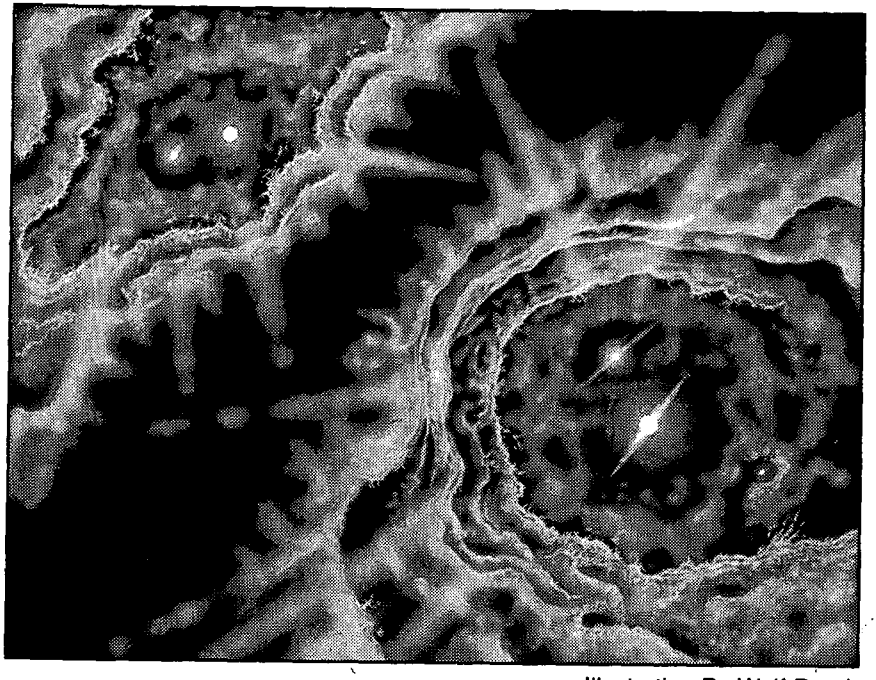

Illustration By Wolf Read

photons of light then present in the Universe, characteristic of a black object with a temperature of about 2,900 K, were released from their trapped "ping-pong match" of repeated emission and re-absorption by the growing transparency. They became free photons, and ever since they have been traveling through the Universe. However, as the Universe expanded and space itself stretched, the wavelengths of these visible-light photons produced by the hot matter in the Universe at a temperature of about 2,900 K, were also stretched until they became microwave photons characteristic of a very cold object with a temperature of 2.7 K. The tiny energy variations left over by inflation show up as variations in the intensities of these microwaves, revealing "the sound of the Big Bang" (see *Analog*, January 2001) at 400,000 years of age. These photons, which have not interacted with matter since the early youth of the Universe, form the cosmic microwave background (CMB) radiation that WMAP was designed to detect and measure.

WMAP was launched into a high orbit on June 30, 2001 aboard a Delta II 7425-10 rocket from Cape Canaveral. It used lunar gravity-assist to put it in orbit at the L2 point of the Sun-Earth system, 940,000 miles behind the Earth, with the Sun on the other side. WMAP detects the CMB in five frequency windows between 23 and 94 GHz in two linear polarization channels. The square root of the observation solid angles of the five frequency windows are 0.88°, 0.66°, 0.51°, 0.35°, and 0.22°, respectively, for the lowest to highest frequency windows. As these small-angle detectors of CMB scan over the sky, they map the power of the CMB at a very small angular scale, where the "ringing" of the early Universe shows up and provides very tight constraints on the various numerical constants that characterize our universe.

Broadly speaking, the WMAP data



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shows (mostly with few-percent errors) that our universe is "flat," that it has an age of 13.7 billion years, that it became transparent and the CMB decoupled 379,000 years after the Big Bang, and that the CMB has stretched in wavelength by a factor of 1089 since that time and presently has a characteristic temperature of 2.725 K. The data also shows that the mass-energy content of the Universe is 73% dark energy, 22.6% dark matter, 4.4% normal matter, and that less than 1.5% is in the form of light neutrinos.

Now let's talk in more detail about the parameters that describe our universe: $\Omega_0$, $\Omega_B$, $\Omega_M$, $\Omega_\Lambda$, $T_{cmb}$, $n_\gamma$, $\eta$, $H_0$, $t_0$, $t_d$, and $t_r$. Here the "0" subscript indicates a time-dependent parameter's present value. The density parameter $\Omega_0$ describes the ratio of the present mass-energy-density of the Universe to the "critical" mass density $\rho_c$ that would exactly "close" the Universe (about $10^{-29}$ gm/cm$^3$). If there were no dark energy, the value of $\Omega_0$ by itself would imply the ultimate fate of the Universe, whether it will expand forever or will re-contract to a Big Crunch singularity. However, with sufficient dark energy, the Universe accelerates in its expansion for a wide range of $\Omega_0$ values. The baryon density parameter $\Omega_B$ describes the fraction of $\Omega_0$ that is provided by ordinary matter (galaxies, stars, planets, gas clouds, atoms, protons, electrons, etc). Similarly, matter density parameter $\Omega_M$ describes the fraction of $\Omega_0$ that is provided by normal matter and dark matter, the two taken together because they affect gravitational attraction in the same way. The dark energy density parameter $\Omega_\Lambda$ describes the fraction of $\Omega_0$ that is provided by dark energy, which we now know accounts for more than two-thirds of the mass-energy of the Universe.

The present characteristic temperature of the cosmic microwave background radiation is $T_{cmb}$, the temperature at which an object would emit the distribution of wavelengths measured by WMAP. The photon density of the CMB $n_\gamma$ is the number of photons per cubic centimeter. It is very large because CMB photons are the most abundant particles in the Universe. The baryon-to-photon ratio $\eta$, essentially the number of protons per photon, is very small for the same reason. The baryon-to-matter ratio $\Omega_B/\Omega_M$ represents the fraction of all matter that is in the form of normal matter, and tells us that normal matter represents only about one-sixth of the total.

The Hubble constant $H_0$ describes the present expansion rate of the Universe. In other words, with $H_0$ = 71 km/sec/Mpc a galaxy 100 million parsecs away should presently be receding from us at a speed of 7,100 kilometers per second due to the expansion of the Universe. The age of the Universe $t_0$ is the elapsed time since the Big Bang, and is a bit larger than the "extrapolated age" given by $1/H_0$ (about $1.1 \times 10^{10}$ years) because of the accelerated expansion caused by dark energy. The time at which neutral atoms formed and photons became free particles is $t_d$. The time duration over which the decoupling process occurred is $\Delta t_d$ and is about 20% of the decoupling time.

The final parameter that we will consider is the re-ionization time $t_r$. Here the WMAP data tells an interesting story. Many of the CMB photons did not pass unscathed from decoupling to detection by WMAP. About 180 million years after the Big Bang, the first stars formed. There was lots of hydrogen around, so the stars that formed first were very massive, became very hot, burned up their fuel fast, and made supernovas and black holes. The abundant ultraviolet radiation produced by these first stars re-ionized some fraction of the interstellar hydrogen, producing a plasma of electrons and protons that interacted with the CMB radiation in a significant way, altering the distribution and changing the polarization of the radiation. These effects are visible to WMAP, and so some of the parameters describing the


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re-ionization era can be extracted from the data.

The table below gives the parameters of the Universe provided by the fit to WMAP data with the best present cosmological model.

With such excellent data, we can ask whether the standard inflationary Big Bang model is completely and uniquely consistent with the data. Interestingly, the answer is "not quite." There remains room for alternatives like the ekpyrotic cyclic universe model of Steinhart and Turock (see *Analog*, April 2002 and January 2003), in which two extra-dimensional "branes" clap together to produce a later-stage Big Bang with no inflation or initial singularity. The issue between that model and the standard scenario will not be resolved until the polarization effects of primordial gravity waves are observed (or *not* observed).

The standard model also leaves us in the dark (so to speak) about the nature of the gravitationally self-repulsive dark energy. Is the amount of dark energy per unit volume of space inert, uniform, and unchanging (Einstein's cosmological constant)? Or is it produced by some dynamic cosmic field that changes as the Universe expands and evolves (quintessence)? The model fit to the WMAP data gives a parameter (not listed above) that relates cosmological negative pressure to the energy density. The value extracted is not well determined, but it is more consistent with constant vacuum energy than with quintessence. However, examination of WMAP data at large angular scales shows that the enhanced fluctuations expected there from constant vacuum energy are missing. This gives the proponents of quintessence some hope that their model may receive some experimental support when better data becomes available.

There is also an ambiguity in the WMAP data because the product of $\Omega_M$ and a quantity called $\sigma_8$, which quantifies density fluctuations inside an 11-megaparsec sphere, is constrained very well, but the individual values of $\Omega_M$ and $\sigma_8$ are not very well determined. By relaxing constraints on $\sigma_8$, the matter density $\Omega_M$ can have any value between 0.1 and 0.5. Thus, the parameters of the Universe may not be as well determined as the WMAP table would imply. However, in no case can one reach a condition where $\Omega_M = \Omega_B$, so that the dark matter problem goes away.

Dark matter is definitely there, we're stuck with it, and we really need to find out what it is. Does it signal the presence of one or more parallel and mutually gravitating universes? Is it in the

**Cosmological Parameters from WMAP Data**

| Description | Symbol | Value ± uncertainty | Units |
|---|---|---|---|
| Total density | $\Omega_0$ | 1.02 ± 0.02 | number |
| Baryon density | $\Omega_B$ | 0.044± 0.004 | number |
| Matter density | $\Omega_M$ | 0.27 ± 0.008 | number |
| Dark energy density | $\Omega_\Lambda$ | 0.73 ± 0.04 | number |
| Neutrino density | $\Omega_\nu$ | <0.015 @ 95% CL | number |
| CMB Temperature | $T_{cmb}$ | 2.725 ± 0.002 | K |
| CMB photon density | $n_\gamma$ | 410.4 ± 0.9 | photons/cm$^3$ |
| Baryon-to-photon ratio | $\eta$ | (6.1 ± 0.3) x $10^{-10}$ | baryons/photon |
| Baryon-to-matter ratio | $\Omega_B/\Omega_M$ | 0.17 ± 0.01 | number |
| Hubble constant | $H_0$ | 71 ± 4 | km/sec/Mpc |
| Age of universe | $t_0$ | 13.7 ± 0.2 | billion years |
| Age at decoupling | $t_d$ | 379 ± 8 | thousand years |
| Decoupling duration | $\Delta t_d$ | 118 ± 3 | thousand years |
| Age at re-ionization | $t_r$ | 180 + 220 —80 | million years |


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form of some unknown particles that might have interesting technical or science-fictional uses? Is it something else? Perhaps we'll find out soon. ■

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***WMAP Data***

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***WMAP and Cosmology***

"Precision Cosmology? Not Just Yet . . .", S. J. Biddle, O. Lahav, J. P. Ostricker, and P. J. Steinhart, preprint astro-ph/0303180 available at http://arxiv.org.

**AV Columns Online:** Electronic reprints of over 100 "The Alternate View" columns by John G. Cramer, previously published in *Analog*, are available online at: http://www.npl.washington.edu/av.


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Probability Zero

# JUST AN AVERAGE GUY

## Richard Foss

Hi Boss. You've probably heard about the problem that we had with the new model humanoid spy, and I figure you should know the whole story. I'm not extruding digits toward any particular entities, but I would like it noted that I was against this extension of our original project and said so from the start.

I have attached copies of the memos I sent reminding you of the danger of trying to pass as a Third Planeter. I understand why headquarters decided to try the strategy anyway after the failure of our animal spy projects. We did a great job of fitting the snooper transmitter into the bears before discovering that Third Planeters don't particularly like bears and generally run away when one is present. The dogs were only a bit less problematic, and the cats . . . I don't want to think about what happened with that, if it's all right with you. Having to blow up part of our own station to keep them from taking over did damage to all of our morales, budgets, and careers. With the new miniaturization techniques, we had promising results with an organism called a mosquito, but funding for that was cut off when headquarters decided to go full speed ahead with the humanoid thing.

That's where the problem was, really. I complied promptly and accurately when headquarters requested the specifications for the target Third Planeters, sending the relevant excerpt of the foremost authority on size, attributes, and abilities. This item is known in Third Planeter parlance as the Guinness Book of World Records, and it is acknowledged as the oldest and most reliable database of this data. It is not my fault that the person in charge of this project misinterpreted some of this information, and despite the comments of some of my associates, I am sure that it is only a coincidence that the high director's crechemate was put in charge of the design team.

The design team director expressed the opinion that these things could be handled without a visit to the planetary system, which would have taken time and budget money that could be more wisely spent on other priorities. (See at-


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tached picture of his newly redecorated office.) He also demanded that the spy be deployed immediately after we received it, ignoring my protest (see attached memo #1188923688235A).

I can understand that the design team director sought to create a spy who was average in all ways, which is the usual procedure for creating our operatives. Upon noting that the lightest adult Third Planeter ever recorded weighed thirteen pounds and the heaviest weighed fourteen hundred and three, the design team director settled on a weight of seven hundred and fifty as a compromise. This is slightly above the correct figure. In the same manner, the design team director settled on a height of seven feet, which wasn't too far off. The real error, in my opinion, was in failing to note that while certain Third Planeters have grown to maturity with four eyes, these are a very rare type called siamese twins. Most Third Planeters have only two. Averaging the eye count to three was definitely an error.

I won't even go into some of the other attributes that the design team director built into the spy, such as the ability to bounce a type of ball for two planetary rotations while riding a contraption called a unicycle and performing a mating ritual called yodeling. Experienced local agents such as myself could have told the design team director that these actions are generally performed separately rather than simultaneously. (The spy was apprehended before even one full planetary rotation had taken place, so the ability to perform these actions for two was not tested.)

Please note that those of us in the advance team did our best to insert the spy among the Third Planeters in the most inconspicuous manner possible. We chose the landing site in the middle of a Third Planeter hive called New York City, which was the most likely place such a being could remain inconspicuous. Despite this foresight, the spy was perceived as suspicious within seventeen twenty-fourths of a planetary rotation and was taken into custody by the local Third Planeter authorities. We initiated the destruct sequence and it melted into the customary amorphous green slime. Since all sentients we know of assume this pattern after discorporation, we felt confident that this would lull their suspicions.

For some reason, it didn't. Just a few moments ago, we observed that a Third Planeter journal of wide intellectual repute published exact details of not only the spy's mission, but of our own base on the dark side of their moon. (See attached copy of *The National Enquirer*.) The article even correctly listed most of our intentions toward the individuals on the planet, though I must say that the natives require considerable use of spices to be more than marginally palatable. We can only assume that the design team director erred in some way and left this data attached to the spy, and as such, we cannot stay here any longer.

We're dismantling the base and getting out of here as soon as we can, taking a circuitous route back to headquarters in case we are followed. Every time I look at the Third Planeters' journal, I get the creeps, and shivers run up my spines. Tell all our other operatives to get out immediately. They're on to us. ■

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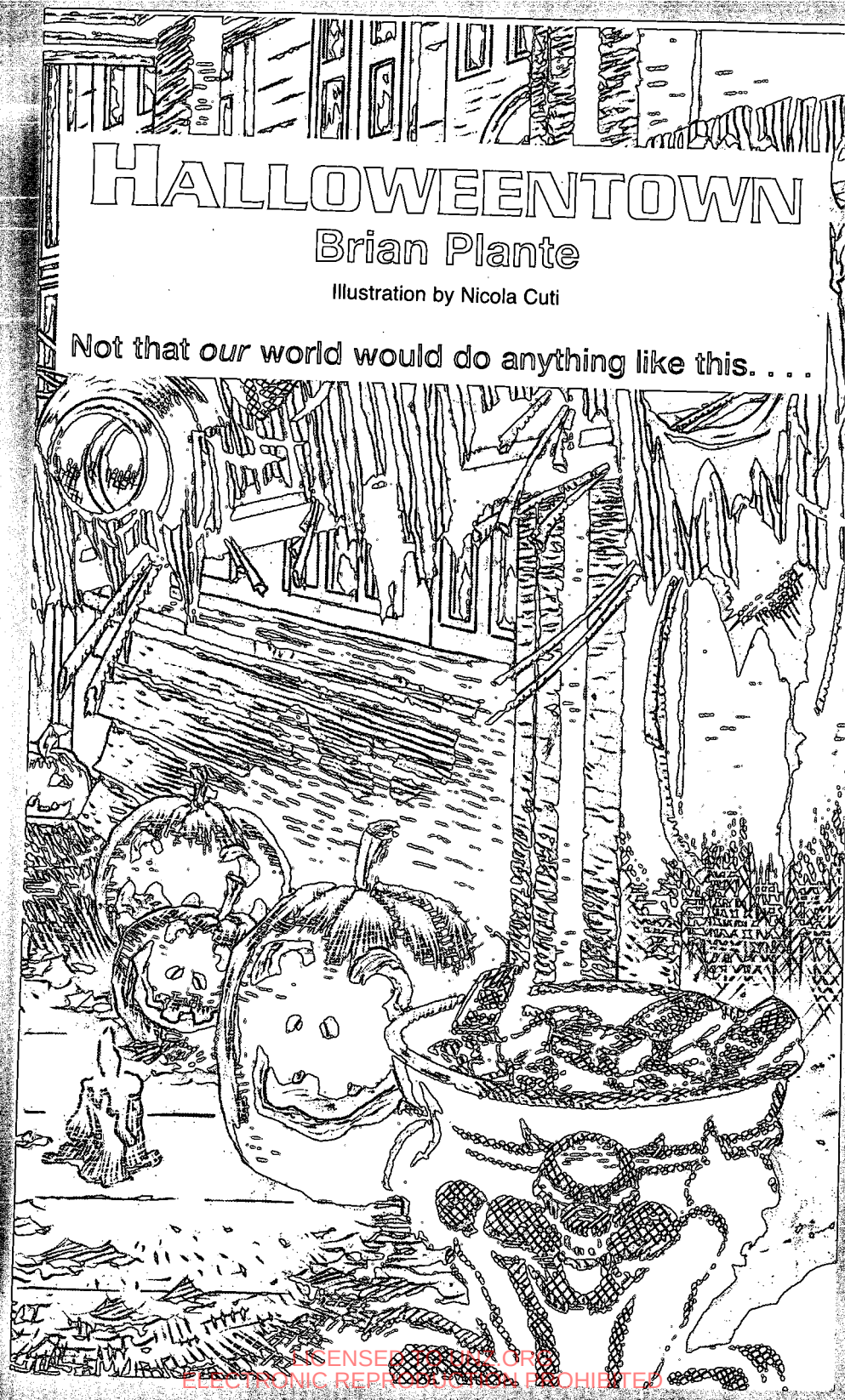
# HALLOWEENTOWN

Brian Plante

Illustration by Nicola Cuti

Not that *our* world would do anything like this. . . .



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One fine Halloween day, in a modern house in a heavily fortified subdivision in a suburb of a declining city that barely mattered anymore, there was a young girl. Eva was her name, and she wanted to go trick-or-treating again this year. Eva's younger brother Ben also wanted to go, but this would be his first year. After the home-school robots had finished with their lessons, Eva and Ben updated their computer tablets with the day's assignments, then waited in the media den for Mom and Dad to finish work.

Mom came out of the back room that served as their home office first, but Dad stayed behind, catching up with the never-ending stream of work that was broadcast into their busy home.

"When are we going trick-or-treating?" Eva asked.

"Right after dinner," Mom replied.

"Yay!" Eva shouted.

"Yay," Ben echoed, although Eva wondered if he understood what he was excited about.

"And I have your costumes right here," Mom said, pulling out a large box that the United Parcel Express man had delivered earlier in the day, along with their regular grocery order. Inside the shipping box was a smaller store box from Virtual-Mart, and inside that were two even-smaller costume boxes from the National Party-Duds Company of Reading, PA. And everywhere in between there were lots of environmentally safe foam packing peanuts.

"Here, put these on," Mom said, handing the costumes to the children. "You can't go out without a costume."

"You mean . . . *outside*?" Ben asked with a quiver in his voice. "Not just in virtual?"

"That's right," Mom said. "Door to door, just like in the old days."

Ben looked sheepishly at his sister.

"Don't worry," Eva said. "You'll see. You ring the doorbell and say, 'Trick-or-treat,' and they give you a treat. It's fun."

"So why do we say 'trick-or-treat'?" Ben said, looking back at Mom. "What's the trick?"

"It doesn't mean anything," Mom said. "It's just an expression."

"Like, 'You're welcome,' when somebody says, 'Thank you'?" Ben asked.

"That's right," Mom said. "Now put on your costumes."

"Last year I went dressed as an auditor," Eva said. Ben looked at her quizzically. "Not the robot kind, but the old-fashioned monster kind, with a green eyeshade that said 'Andersen' on it, real eyeglasses, and a calculator." Ben looked dumbfounded, so Eva added, "A calculator is like a computer tablet before there *were* computer tablets."

"Eyeglasses?" Ben muttered. Nobody wore eyeglasses anymore, except in the really old holovision shows.

Eva and Ben tried on the costumes from the Party-Duds boxes, putting them on over their house-clothes. The costumes didn't look too much different from regular, worn-out clothing, but there was some artificial dirt and stains, some imitation tears in the fabric, and even a few places where phony skin peeked through from behind mock-threadbare patches. There were even a couple of dusty-looking hats of a style that folks hadn't worn for nearly a hundred years.

"What are we supposed to be?" Ben asked.

"The box says *Hobo*," Eva said. "Mom, what's a *hobo*?"

Mom picked out the little packets of artificial, sterile dirt from the costume boxes and smeared some on the children's faces, to complete the outfits. "Hobos are the poor people who live outside the gates," Mom said.

"More monsters," Ben said, "just like the auditor."

"That's right," Eva said. "On Halloween, you dress up like monsters."

Dad finally came out of the back office, and surveyed his costumed children. "Amelie, what are these two little homeless kids doing in our house?"



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"Surprise!" Ben said. "It's just us!"

They laughed and laughed. Later, Dad scanned Ben and Eva with an imager, and Eva thought they looked very scary indeed as Dad made their animated figures walk from door to door on the screenwall, trick-or-treating in some virtual neighborhood. Ben studied the images intently, learning what it was they were expected to do when they got outside.

At dinnertime, the kitchen robot served the family a festive Halloween meal of orange and brown factory food, arranged artfully on their plastic plates. It tasted just like the regular red and green factory food: safe and comforting.

"You didn't have to buy these costumes," Eva said between pre-measured bites. "We could have just taken some of our old clothes and ripped them up a bit."

Mom looked horrified. "But then, people would think we're *poor*. We bought you nice costumes, so you can be just like everyone else."

"Will we visit the house next door?" Ben asked. "I've always wanted to see who lives there."

"No, no, that's too dangerous," Dad said. "You never know what sort of people are lurking behind closed doors, even inside the neighborhood gates. We're taking you to Halloweentown."

"Halloweentown! Yay!" said Eva. She had gone trick-or-treating at a Halloweentown last year.

"Yay," said Ben, dubiously.

The chauffeur robot drove them into the old city. It was a dark and strange place, all cracked concrete and broken glass, with no walls at all around the neighborhoods. Eva barely remembered any of it from last year's trip. The car slowed as they approached a huge, gloomy building.

"Didn't this used to be the old convention center?" Mom asked.

"Well, back when there still *were* conventions," Dad said.

Eva looked at the building. It covered nearly as much ground as their whole neighborhood. "What's a convention?" she asked.

"In the old days," Dad said, "people used to get together to network. Nowadays we do it all in virtual, but back then, people liked to go places and meet face-to-face."

"Ewww," Ben said.

"It was a scary time," Mom said. "But you're my brave little boy. You're not going to be afraid to ring the doorbells, are you?"

"No, Mommy," Ben said in a very small voice.

As they neared the large garage doors, a dark figure shambled in front of the car.

"Please step away from the door," the chauffeur announced over the car's loudspeaker. "This vehicle is equipped with antipersonnel defenses. Please step away."

The figure took one staggering step toward the car, and Eva was alarmed that the chauffeur might actually have to zap him, but the man apparently thought better of it and fled into the shadows.

"Who was that man?" Eva asked.

"Probably just some homeless person," Dad said.

"A hobo!" Ben cried. "Just like us!"

"But he was a *real* hobo, and hobos are monsters," Eva reminded Ben.

The chauffeur transmitted the family's access code to the Halloweentown gatekeeper robot, and the big garage door opened to let the car in.

It wasn't nearly as dark inside the big building as outside, Eva noted. There were several hundred other cars in the well-lit, cavernous parking garage. A few groups were walking through the garage, so Dad made the family wait in their car until the coast was clear. "No need to get too close to other folks," he explained.

From the walkway above the main



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convention floor, the family looked down on the Halloweentown through large glass windows. The floor was divided up into miniature blocks by a grid of simulated streets and avenues. On each block were four or six little houses, about a hundred in all, with each one slightly different from its neighbors, but all decorated with generic, factory-made Halloween trappings.

"It looks smaller than last year," Eva said.

"You're just getting bigger," Mom said. "I remember when you still thought it was a real town."

Eva looked down at the other kids in their mail-order costumes, already on the Halloweentown floor. To them, on the "streets," it probably looked convincing enough, but from up here, she could see the unfinished roofs and cardboard walls. It was all just for show.

"I can't see everything from here," Mom said. "Robert, will you get them one of those hummingbirds?"

"Of course," Dad said. "Just like last year."

The family took the escalator down to the main floor level and Dad pressed some buttons and waved his smart-chip near a self-serve console to order the hummingbird. It came flying out of a cabinet carrying its own homing button in its beak, and alighted on the control panel. Dad took the homing button and pinned it on the front of Ben's costume. The hummingbird would hover six feet behind Ben, as long as he still had the button, and Mom and Dad could watch the goings-on upstairs in the video lounge, through the hummingbird's tiny camera.

"Be brave, and don't forget to say trick-or-treat," Dad said, as the children entered the gate into the Halloweentown.

*It doesn't mean anything*, Eva reminded herself.

"And say thank you for whatever you get," Mom added.

*That doesn't mean anything either*, Eva thought.

The streets of Halloweentown were marked with a painted green line and arrows to show which way to go. Eva led Ben a short distance to the first "house" on the right. It looked like it was made of bricks, although she knew it was just plaster and cardboard. Scary shadows moved across the curtained windows and some creepy music could be heard faintly over the sounds of other children.

"Ring it," Eva said, pointing to the doorbell button.

"You ring it," Ben said. "You're older."

"Okay, I'll ring this one, but you do the next," Eva said as she pushed the button.

Inside the house, the muffled sound of chimes echoed. A dog barked and footsteps approached the door.

"I'm afraid," Ben said. "Someone's coming."

"That's the whole point, silly," Eva said, although she was secretly frightened, too.

The knob turned and then the door opened slowly, with a creaky moan. Inside was a robot dressed in a bear costume. It was easy to tell it was a robot, Eva thought—you could see it had the jerky walk just like all the other robots that moved on legs instead of wheels. Eva looked past the robot and saw that the inside of the house was just a shell, with four bare walls and no furniture inside. She could still hear the sound of a dog barking, but there was no dog in sight.

"Grrr," said the bear robot.

Ben started to shake, but Eva held out her bag and said, "Trick or treat!" Ben was slow to follow her lead, so she whispered to him, "Say it, 'trick or treat'."

"Trick or treat," Ben repeated, and shoved his bag out in front of him like a shield.

"Well now," the bear robot said, "who are you two supposed to be?"

"We're hobos!" Ben said. "Aren't you scared?"



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"Oh, yes," the bear said. "I'm very scared. I'll give you a nice treat, so no tricks, all right?"

Eva and Ben nodded their heads, and the bear took two plastic packets out of a large shipping crate on the floor and dropped one each into their goody bags. "Happy Halloween," the bear said.

"Thank you," they both said and stepped back into the street.

"What did we get?" Ben asked, peering down into his goody bag.

Eva reached into her bag and pulled out the plastic packet. In it was a software gem. Probably some educational program that would teach them a lesson on history or science when it got close enough to their computer tablets to transmit a signal, Eva guessed.

"That's it?" Ben asked. "A lousy software gem?"

"Let's try another house," Eva said. "You ring the bell this time."

The next house was only a few dozen feet away, following the green line and the arrows painted in the street. This one was a red crystal-finished structure with a tree in front that was rustling gently, even though Eva couldn't feel any wind. Ben rang the bell.

The door was answered by another robot, this one dressed as a scarecrow. The scarecrow robot gave both of them a cube puzzle that spoke directions and guided the user along to its solution. No child would ever grow frustrated, and everyone would be a winner with the self-solving puzzle.

Eva and Ben visited the next six houses in a row on that side of the street, quickly falling into a rhythm. Several of the costumed robots merely asked for Ben and Eva's smart-chips, and ran them through a scanner that added a dollar to their account balances. As if a dollar was worth anything these days.

Working the other side of the street, an obese boy in a motorized cart passed them by, visiting every house along the way. The boy never actually got out of the cart. At each stop, a small helper robot detached itself from the cart, rolled up to the door, rang the bell, and announced, "Trick-or-treat," and retrieved the offered prize. Occasionally the bored boy waved some feeble thanks to the various robots manning the doors.

Ben also appeared bored with the business of trick-or-treating, and seemed more interested in trying alternately to elude, then catch the hovering hummingbird as it flitted about them. The mechanical bird deftly remained close, but never near enough for him to grab. After a half hour, the children had canvassed all the way up the first long avenue, around a corner, and were starting back down the next avenue, still following the painted green line. Their goody bags were growing heavy with educational toys, software gems, nutritional supplements, immunity boosters, sound beads, and various other trinkets of minor value and minimal fun.

At the next intersection, Eva said, "Why don't we be naughty and just cut across to the next avenue instead of going all the way down to the end of this one and then back up?"

"But the green line goes this way," Ben said.

"This is just a shortcut," Eva said. "We'll pick up the line again on the next avenue."

Eva started walking down the cross street, abandoning the longer avenue, and Ben tagged along. He kept looking over his shoulder at the hummingbird, which was trying to herd them back in the right direction.

"Don't worry about the camera," Eva said. "Mom and Dad told us to be brave, so we're being brave and exploring."

Ben gave a tentative wave to the hummingbird. On the next block, they ran into a group of four young boys, also taking the cross street as a shortcut, but on their way out. The boys were dressed in baggy, shapeless costumes.

"What are you guys supposed to be dressed as?" Ben asked.

"We're bacteria!" one of the boys said.



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"Is there any good stuff up this way?" Eva called, mindful to keep her distance from the strangers, "or is it just more junky things?"

The boys held out their bags, nearly overflowing with the same unwanted prizes that Eva and Ben had already collected.

"There's a witch in the last house on the left," one of the boys said.

"Yeah, don't miss the witch," another said. "She was the scariest one, and had some weird treats."

The houses on the next avenue were much like the ones on the first row. They collected more trinkets. One robot, dressed as a sailor, gave them a pencil and a sharpener.

"What are these?" Ben asked.

The sailor robot explained that the pencil was an older sort of stylus. You inserted one end of the pencil in the sharpener and twirled it, and it made a point that you could write with. The other end of the pencil was like a soft pink delete key that would erase whatever you had written when you rubbed it across the text. But instead of writing on a computer tablet, the pencil was made for writing on paper.

"What sort of paper are we supposed to write on?" Eva asked. "Dad would kill us if we messed up any of his antique books."

"You must have skipped a house," the sailor robot said. "If you go back down the avenue to the one with the blue door, you'll receive a pad of paper as a treat. It has lines, and you can write your name on it."

Ben and Eva thanked the sailor robot and went back out onto the street. Neither of them wanted to bother going back for the writing paper, so they just kept following the direction of the green arrows. Eva tried sharpening her pencil, but it made a pile of little shavings in her goody bag and dirtied a couple of her fingers with some shiny black dust. Mom would be annoyed at the mess.

Eva tried writing her name on the outside of her goody bag, but the pencil refused to make a steady line on the shiny plastic, and she finally gave up and dropped the pencil in the gutter. Who ever heard of a pencil, anyway? Voice-writing was all they really needed. Even old-fashioned finger-typing was easier and less messy than the pencil scratching.

At the next intersection, they cut across another side street and skipped one more large section of the Halloweentown. The trick-or-treating was getting repetitious and both of them were in a hurry to finish.

They collected some more trinkets along the last avenue from a robot butler, hunter, baseball player, farmer, astronaut, and a zebra. Finally they reached the last house on the left side of the last avenue: the witch's house.

Eva rang the doorbell, glad that the trick-or-treating was nearly over. This year's Halloweentown wasn't as much fun as she remembered from last year. As the door opened, she began to recite an unenthusiastic, "Trick-or-treat," but stopped short when she saw the figure behind the door was not a robot as she had expected. It was a *real* person. An old lady, older than anyone Eva had ever seen before, dressed up as a witch.

"You're not a robot," Ben said, hiding behind his sister.

"That's right," the old lady said, waving them into the miniature house, "I'm a witch."

"People don't give out treats," Eva said. "Robots are supposed to do that."

"No, they're not," the old lady said. "At least, not when I was younger, they didn't. Regular folks gave out the treats, or else the kids played tricks on them."

"There's no such thing as tricks," Ben said. "It's just an expression."

The old lady laughed, and held open the door for them. "Well, there used to be tricks: soap on the windows, eggs on the roof, toilet paper in the trees, flaming bags of dog poop on the doorstep.



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You kids don't know anything. Come on in and I'll tell you about Halloween—the real Halloween. But don't let that nasty little bird robot follow you in. I won't have it in my house, even a crummy little imitation house like this."

Ben looked timidly at Eva. "We're not supposed to talk to strangers."

Eva shrugged her shoulders. "She's not really a stranger; she must work here. And the other kids said she has good treats."

"They said she had *weird* treats," Ben corrected.

"Come on."

"But the hummingbird," Ben pleaded, looking behind him.

Eva reached over and plucked the hummingbird's homing button off the front of Ben's costume. She walked a few paces back toward the street and dropped the button on the sidewalk. The little bird circled about the button, looking back at the children but unable to follow.

"Are you sure you can do that?" Ben asked.

"Come on, be brave," Eva said.

Inside, it wasn't a real house but merely another bare shell. There were four rickety folding chairs arranged around a large packing crate that served as a table. The crate was marked "GEO-124 Module" so Eva guessed another educational software gem was going to be the treat. What was so weird about that?

"I'm sorry the house is so empty," the old lady said, "but I'm limited to what I can carry in. I'm not as strong as I used to be."

"You work here, right?" Eva asked. "I mean, you're not just some . . . hobo that sneaked in, are you?"

"Oh, no," the old lady said. "I work here all right. The folks who put the Halloweentown together always like to have one or two experienced people like me who have been around long enough to remember what Halloween was really like in the old days. I keep telling them they have to get rid of all the dumb robots and give kids some treats they really want. When I was a girl, we used to get Snickers, Almond Joys, M&M's, and Reese's peanut butter cups. Yeah, I think the Snickers were my favorite. We'd eat some along the way, then have more when we got back home, and lay in bed with upset stomachs from too much candy. It was wonderful. So what treasures did you kids collect on your travels tonight?"

Ben held his goody bag open for the woman to have a look.

"Hmmm," the old lady said, looking over the contents and scowling. "Computer stuff . . . pills . . . nothing very fun-looking."

"What kind of treat are you going to give us?" Eva asked. "Another software gem?"

The old woman pointed to the packing crate. "Well, I do have some of those, but I think you have enough of that sort of thing already. How about something different?"

"Different?" Eva said. "Different *how*?"

The old lady got up and walked over to the corner of the room where a large plastic bag lay on the floor. She bent down and retrieved two red, fist-sized objects from the bag.

"In my day, these probably wouldn't have been considered very good treats," the lady said. "And a lot of kids wouldn't have been allowed to keep them. Even back then there were mean people who might have put a pin or a razor blade in one of them."

"What are they?" Eva asked.

"They're apples. You can't hardly find a piece of real fruit these days."

"An apple?" Ben said with a confused look.

"You know," Eva said, "'A is for apple,' like in your reading lessons. That's what they make applesauce and juice from. Is this how they come from the factory?"

"Factory?" the woman said. "Why no, no factory. I grew these myself from a tree in my backyard."



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"But they look so odd," Eva said. "What are we supposed to do with them?"

"Why, you eat them, of course," the old lady said.

"Um, maybe we'll try it back home," Eva said.

"If our parents will let us," Ben added.

Eva instantly recognized the truth in Ben's words. Mom and Dad would never let them have anything so different, so strange as an apple. *Be brave*, she thought.

"Could I eat it here?" Eva asked.

"Why, sure," the woman said. "That's probably for the best, if you think your parents might take it away."

Eva put the red fruit to her mouth. It didn't dissolve on her tongue like regular factory food, so she pulled it back and inspected it."

"It's got a skin on it," the woman said. "It's okay to eat that too, but you'll have to bite through it. It's probably a lot crunchier than most of the pap they feed you."

Eva put the fruit back to her mouth and bit down. It did indeed make a loud crunch as her teeth pierced the skin, and was unexpectedly moist inside.

"It tastes a bit like juice, but maybe not as sweet," Eva said, still chewing the first bite while she inspected the fruit in her hand. "It's . . . not bad." She lifted the fruit and took another larger bite.

The old woman smiled and Ben's eyes widened. Eva held the fruit out to Ben. "Try some. It's really good."

Ben seemed unsure. "Is the tree in the back of this house?"

"No," said the woman, laughing. "This isn't really my house. None of this is real. Just a few antiques like me are real, here. The rest is all just bullshit."

Ben's mouth opened to form a perfect little "O." He turned and whispered to his sister, "She said a bad word!"

The teaching robots never said words like "bullshit." Dad had said it once and Mom yelled at him, but Eva and Ben knew it was something that polite people weren't supposed to say.

"But the apple is real," the old woman said, oblivious to the fact that the children hadn't yet recovered from hearing the naughty word. "Why don't you be brave like your sister and take a little bite?"

"Are you really a witch?" Eva asked.

"Yes, I suppose some people would say I am," the old woman said. "Kids had so much more fun when I was young. Things were more dangerous, but perhaps a little bit of danger made it more interesting. Parents take all the fun out of being a kid these days. Yeah, they'll probably call me a witch."

Eva wasn't put off by the answer. Instead, she moved the apple closer to Ben's mouth. His face underwent several changes, from fear to doubt, then a softening, and then finally a look of resolution. He would take a bite.

Just at the moment the moist fruit touched Ben's lips, there was a loud cracking sound and the world moved around them. The walls seemed to lift up, and light spilled into the room from the edges of the floor on all sides, as the house split apart.

"Please back away from the children, Mrs. Serpico," a sharp robot-voice called from the spot where the front door had been.

After some initial disorientation, Eva realized that the walls and roof of the old lady's "house" were being lifted in one piece straight up above them, leaving the three of them exposed on the bare concrete floor of the Halloweentown. A handful of people and robots rushed into the space as soon as the house was up high enough to step under the rising walls.

The robots were heavy security models, and the people with them held stunners at the ready. The old lady, Mrs. Serpico, frowned and her shoulders drooped as she was surrounded by the sudden crowd of men and mechanicals.

Ben started to cry, and a nanny robot



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said in a pleasant voice, "Come along with me, children." The nanny-bot lead them back out to the street, where Mom and Dad, with looks of deep concern visible on their faces, were watching Mrs. Serpico's capture from a safe distance.

During all the confusion, Eva dropped her apple.

"Did she hurt you at all?" Dad said, while Mom hugged both of the kids tightly. "I'll kill her if she touched either one of you."

"She didn't do anything," Eva said. "She was just telling us how Halloween used to be in the old days."

"We paid good money for this Halloweentown," Dad said, not listening. "How could the people running this place let something like this happen?"

"Nothing happened," Eva said.

"Look what the witch gave us," Ben said, displaying his still-uneaten apple.

Mom and Dad took a few seconds before they recognized what it was.

"Drop it, Ben," Mom said. "It's probably full of germs."

"It could be loaded with poison," Dad said.

*Bullshit*, Eva thought, still rolling a tiny morsel of raw apple around in her mouth. But she didn't say it aloud.

Dad slapped Ben's hand, making him drop the apple. It fell to the concrete floor and rolled across the green line in the middle of the street.

"It's just an apple," Ben said. "You know, like in 'A is for apple.' The old lady said it grew in her backyard."

"Nothing that's safe to eat grows by itself," Dad said. "You don't know where it's been. That witch is going to go to jail for this."

Two of the human security officers approached the family.

"Our sincerest apologies, Mr. And Mrs. Adams, and to your two children as well," said the first officer.

"We assure you that this woman will be prosecuted to the fullest extent of the law," said the other.

"And we'll see to it that this can never happen again. You can be sure that additional security checks will be set up for all temporary employees from now on."

"Of course, your admission costs will be gladly refunded, and we hope you'll return to our Halloweentown next year as our guests."

Dad glared at the two men and looked like he was ready to hit one of them.

"Leave them alone," Mom said. "The kids are all right."

"You can be sure I'll be speaking to my attorney about this," Dad said.

*Bullshit*, Eva thought again, sucking the last drop of juice out of the piece of apple in her mouth.

"I'm so sorry this had to happen," Mom said for the third time, in the car on the way back home. "Halloween is supposed to be a fun time, and then something like this spoils everything."

"It's okay, Mom. We *did* have fun," Eva said. "Right, Ben?"

"Yeah, fun," Ben said, not really listening. He was busy playing with the self-solving cube puzzle, delighting in turning the sides incorrectly on purpose and letting the toy tell him politely that he was going about solving it the wrong way.

"It really was," Eva said. "Even the witch lady was pretty interesting."

"You just can't be too careful with so many crazy people loose in the world," Mom said. "She really *was* a witch."

Eva rummaged around in her goody bag, turning over all the educational trinkets and nutritional supplements. She'd have to ask her teacher robot what a "Snickers" was when she got home.

*Maybe one day*, Eva thought, *I can be a witch, too.* ■



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# MOONSTRUCK

## Part Two of Four

Edward M. Lerner

Illustration by Vincent Di Fate

**How much can an artist sacrifice for his art?**

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*Synopsis of Part One*

*Presidential science advisor KYLE GUSTAFSON hosts his Russian counterpart, SERGEI ARBATOV, at a Cape Canaveral space-shuttle launch.* Atlantis *carries the replacement for the Gamma Ray Observatory mission that ended in 2000. The absence of space ambitions beyond low Earth orbit is a disappointment to both men—especially Kyle, whose love of science began with the Apollo 11 moon landing. Shortly after takeoff, pressure in the shuttle's external tank inexplicably rises.* Atlantis *and its crew are lost in a spectacular explosion.*

*Television preemptions herald the arrival of representatives of a Galactic Commonwealth. Kyle briefs his boss and mentor, presidential chief of staff BRITT ARLEDGE: the Moon has acquired a satellite more than two miles across. An alien landing craft comes to Washington's Reagan National Airport, where President HAROLD ROBESON greets the embassy mission. The F'thk visitors, led by Ambassador H'FFL, are taller than humans, scaled, and vaguely centauroid.*

*At a state dinner, the F'thk explain their antimatter-powered mothership is far off in lunar orbit as a standard precaution. They deflect Kyle's questions about this ultra-conservatism. The state "dinner" is foodless, since F'thk food is toxic to humans—but sensors find no trace of toxins in the ballroom's air. A visitor says of Earth, "No F'thk would invent such dark nights or such a paltry number of moons."*

*Deputy Undersecretary of State DARLENE LYONS joins Kyle on Washington's Mall, where with great pomp the F'thk donate a "Galactic Fellowship Station." The miniature factory dispenses souvenir orbs symbolizing galactic unity. Darlene wonders why the aliens didn't first visit the UN in New York City rather than a national capital. The F'thk had mastered human languages from radio broadcasts; she cannot believe they were unaware of the UN. The F'thk give orbs personally to all officials with whom they deal.*

*Kyle is named head of the Presidential Commission on Galactic Studies. Its challenge: evaluate an invitation to apply to the galactic commonwealth. Kyle fast-tracks a replacement for the lost orbiting observatory: gamma-ray production is a hallmark of the matter-antimatter reactions said to power the mothership, and the atmosphere blocks gamma rays. Sensitive videocams in a windowless room whose lights are suddenly extinguished capture ultra-rapid dilation of F'thk pupils. Would such light-sensitive eyes evolve, Kyle wonders, on a world with many moons? The commission votes to negotiate with the enigmatic F'thk, and Kyle resigns in protest. He returns to his former employer, the Franklin Ridge National Lab.*

*Kyle's alien research is interrupted by an insanity mankind thought it had outgrown: nuclear saber-rattling. Against a backdrop of resurgent Russian nationalism, one American spy satellite after another falls silent. Final telemetry suggests ultra-strong X-ray lasers; Kyle questions how the Russians could generate such powerful beams. Darlene shares his suspicions of F'thk meddling: Ambassador H'ffl has privately discussed a split in the Galactic Commonwealth between individualistic and authoritarian factions. H'ffl suspects an authoritarian agent hidden within his delegation. A civilization-ending nuclear war on Earth, should that happen, would at worst leave unchanged the familiar Galactic stalemate.*

*Kyle's colleague, fellow physicist HAMMOND MATTHEWS, proves the orbs are bugging devices, responsive to microwave pulses from space. Backtracking the beams, researchers find radar-stealthed (but, as they re-radiate absorbed sunlight, obvious to infrared sensors) satellites. Missile launches*



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*from Earth cannot go unobserved; the stealthy satellites must have been put into orbit by the aliens. Russian spy satellites also begin to tumble—apparently dead, like their American counterparts. Britt accepts Kyle's deduction: aliens frying both nations' spysats, and aliens bugging—and whispering to—the leadership of both sides are behind the march to war.*

*A Russian heavy-lift Proton 2 missile carrying a replacement American gamma-ray observatory (shuttles still being grounded) explodes in flight—and telemetry reveals intense microwaves. Several stealthy satellites are seen firing masers at the same time. This must be how* Atlantis *was destroyed: by microwave-induced boiling of its fuel.*

*Plainly, Earth is at war. The question was* why? *And did anything but squeamishness prevent the aliens with their vastly advanced technology from directly acting on their covert animosity?*

*SWELK, a social-scientist passenger on the Krulchukor starship* Consensus, *is congenitally lame in one of three limbs. With limbs and sensor stalks every 120 degrees, a normal Krul sees, hears, moves, and manipulates equally well in all directions. Krulirim have a radially symmetric worldview; a Krul locates objects by distance from her body and angle relative to her bearing on the nearest magnetic pole. Swelk's deformity makes her "sided," an orientation utterly foreign to her kind. In a species intolerant of birth defects, Swelk is an outcast.*

*Swelk recalls how, on a long interstellar passage, she isolated unexpected radio signals, decoded them, and tracked them to an unknown intelligent species. The ship's captain, GRELBEN, was disinterested—every intelligent species known to the Krulirim had let its technology destroy them. To Swelk's surprise, fellow passenger RUALF convinced Grelben to detour. Upon reaching the humans' solar system, Swelk becomes more ostracized than ever—even as Rualf and his holofilm company become engrossed in* something *from which she is excluded.*

Consensus *carries an alien menagerie destined for a home-world zoo. Swelk offers to muck out the beasts' cages, correctly reasoning the crew won't enter the foul-smelling ship's hold to harass her. Abutting the hold is a lifeboat with radio gear . . . and to Swelk's confusion, Earth's airwaves mention not Krulirim, but a Galactic Commonwealth, and F'thk visitors, totally unknown to her.*

*Rualf invites Swelk's sociological opinion of a recording on human international relations—a war council implausible to have been broadcast or shared with a Krul visitor. Her questions lead Rualf to an admission: film-company recording gear is in use. Rualf points out one such device in a scene's background. It is a "galactic" orb.*

## Part Two

### CHAPTER 12

Somehow Swelk maintained her composure long enough to complete the conversation with Rualf. She limped to her cabin, too attentive to her own thoughts to take notice of the crew's taunts.

The F'thk were distributing bugging devices, which Rualf implied were Krulchukor technology. Data from those devices were being exploited by the officers and other passengers of the *Consensus*. Conspirators, she decided was the correct and much shorter term. Either the conspirators were in league with the F'thk, or the conspirators *were* the F'thk. In either case, what could possibly be the purpose of the conspiracy?

Dropping wearily onto her sleep cushion, she could not decide which theory was the more unimaginable. Of all the group she now labeled conspirators, none but Rualf could for any length of



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time disguise his repugnance for her deformities. Their distaste was equally plain for the alien intelligences previously discovered by the Krulirim. How could they possibly be cooperating with the F'thk? Look at their attitude towards the humans. It all seemed so psychologically unlikely.

But the alternative was not physically possible. How could the F'thk *be* Krulirim?

And yet: how could the F'thk *not* be the Krulirim? The human media showed no other aliens.

A gurgling stomach reminded her that she had missed the last two meals. Swelk dug through a stockpile of prepackaged rations she kept in her room, her company in the *Consensus'* galley seldom being appreciated by her shipmates. What a delightfully uncomplicated pleasure: to pick some food and eat it. So few of the concepts swirling through her mind were ever simple any more. Certainly, none were pleasant.

The practicality of her task brought a fresh perspective. There was at least one variable that she could eliminate, with no subterfuge required. She called up the ship's library and located a picture of the ship in which she sat chewing.

Despite her suspicions, she almost choked at the hologram that appeared. Either the F'thk landing ship was the *Consensus*, or the F'thk had found its clone.

No clone: some of the broadcasts stored in the data banks of the lifeboat were real-time reports of F'thk landings. Timestamps for those recordings matched what Swelk knew to be landings of the *Consensus*. Even physical locations matched.

Everything was consistent . . . and everything inexplicable. And what, if anything could or should be done about it?

"You have *got* to help me, Rualf."

The entertainer peered dubiously at Swelk. She had just been quite useful in interpreting one of the odder broadcasts from Earth. "Help you with what? If you refer to your issues with the crew, sorry—I will not get in the middle of that."

A dip of her sensor stalks suggested *you can't blame me for trying*. The shrug was a deception, something for Rualf to reject so that a lesser request might be granted in consolation. "I suppose not. I need distraction, is all. There is a great deal of nuance to Girillian dung, at least for someone with my level of expertise, but I have almost exhausted the possibilities."

"What did you have in mind?" His stance conveyed guardedness.

"You and your friends, your troupe. You make movies, correct?"

"Of course." The posture relaxed. He knew all about dealing with fans. All fans were odd—their strangeness was just not usually so visually evident.

"Well," she tipped towards him respectfully, "I've never actually known anyone in the entertainment field. I wondered if you had recordings of some of your troupe's films that I could borrow to view in my room."

"Wait here." He popped into his cabin, returning with a standard computer storage cube. "Enjoy."

"Oh, I'm sure that I will find your work *very* interesting." He did not seem to take note of the potential difference between interest and enjoyment.

The swampbeasts had come to trust Swelk, *humphing* in welcome when she arrived, hanging their heads sadly when she left. The show of affection deepened her guilt without altering her resolve—and caused her to shift the food tampering to another pair of creatures. So far those large limbless crawlers showed no signs of eliciting her sympathies.

She limped from cage to tank to stall, cleaning up the various messes. Despite her eagerness to see what new uncensored information awaited in the lifeboat, she took pleasure in her task. It



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was nice to be appreciated, even if only by a swampbeast. She stroked their fur carefully with a long-handled brush, bringing forth more contented *humphs*. Even the hold's smell was becoming familiar.

Or was it abating? That would be bad, stench being the main guarantor of her privacy. Steeped in shame, she synthesized fresh batches of nutritionally deficient animal fodder. For good measure, she spilled some feces near the hold's main door, to be sure to track some into the corridor later.

The lifeboat computer kept selecting more broadcast material than she had the time to review. She sampled and skimmed, without obtaining answers to what was, in her mind, the biggest question: why did the *Consensus* pretend to be what it was not?

Swelk whistled softly to herself in amusement: the beasts she tended were always themselves—and the only beings on board to enjoy her presence. If the humans did not destroy themselves, would she be allowed to establish a relationship with some of them?

A foolish notion, but it suggested another. The conspiracy she suspected, its form still obscure, its purpose unknown, seemed too much for her alone to uncover. There were, however, countless humans. Did any of them have doubts? If such could be found, could she and they somehow help each other?

She reconfigured the lifeboat's broadcast search to select information on anyone who had expressed skepticism about Earth's interstellar visitors, then returned to her duties in the hold.

Without enthusiasm, Swelk accessed the index on Rualf's data cube. It turned out to contain three-squared and three movies. Searching them for clues, to exactly what, she could not even guess, would take a while.

Sooner started, sooner finished. She told the computer to run through all the contents in storage order. Most of the actors she recognized from shipboard encounters, not only Rualf: the same group, as typical for Krulirim, had worked together for a long time. That did not mean that she could put names to them; many of the troupe ignored her.

She fell asleep to the quiet drone of the third film. Like the stories that had preceded it, this movie involved a perfect character who had lapsed into the slightest bit of individuality, becoming unhappy and stressed as a result. Even Krulirim were not as variety-free as these films suggested. Creativity and exploration require initiative, even if the common culture chose not to recognize it. What boring drivel. . . .

Sleep was a vulnerable time for any Krul, slumber's sensory shutdown in such utter contrast to normal awareness in all directions at once. No one could sneak up on one of her kind—except in her dreams.

Krulchuk was a planet with active plate tectonics, its interior kept hot by the slow decay of an overabundance of thorium and uranium. Without that internal energy source, Krulchuk would have been inhospitable to life, as far as it was from its sun. Without the high background radiation, the evolution of its unlikely life would have been much different. And without the constant upwelling of magma, first driving the continental plates apart and then reuniting them in tremendous convulsions, and the attendant shifts in oceanic circulation, Krulchuk would not have experienced regular cycles of ice ages and warming.

Multicellular life arose soon after one such break-up of a temporarily unified mega-landmass. The continents that resulted drifted separately for eons, each a laboratory for evolution, before they next crashed together. The distant ancestors of the Krulirim were suddenly in a fight for survival with the offspring of a different path: bilaterally symmetric creatures. The trilateral ultimately prevailed; the bilateral disappeared without a trace



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until Krulchukor science discovered the fossils of the vanquished monsters.

A few scientists whispered that a random metabolic mutation within the trilateral phylum better suited them to Krulchuk's next ice age. Their theory, that trilateralism itself was not inherently superior, remained controversial.

Whatever had caused the great die-out of the bilats, their fossils were an immediate sensation, instantly recognized by some primitive underbrain survivor of that dawn-of-time struggle. The unnatural beings that sometimes appeared to Krulirim in their vulnerable dream states suddenly were *of* nature, and more frightening than ever.

Rualf's character howled dramatically in another overacted film. The emoting disturbed the dozing Swelk, who opened one eye in reflexive curiosity. She shrieked herself, suddenly alert. It took several deep breaths to slow her pounding hearts.

She had wakened during a dream sequence in which Rualf wrestled with a monster from his inner mind. A horned and fanged bilat, its talons and the corners of its mouth dripping gore, a creature to whom the term nightmarish truly applied.

Rualf vanquished his inner beast, enriched by the recognition that it symbolized his less than perfectly social ways. As the film ended, the actor sought out the communal embrace of his neighbors. Big surprise.

Credits rolled. There was a prominent credit for robotic effects. Her first reaction had been that the bilat was a computer-generated graphic. A robot made sense, though: the creature and Rualf had been so entangled in their fight.

A robot. Swelk rewound the film to the dream sequence. The monster seemed to be a cinematic amalgam, a composite of the scariest old fossil finds and the director's imagination. "Enough movies for now," she told the computer. "Does the ship's library have an encyclopedia?"

"Yes."

"Show me an overview of extinct Krulchukor bilats." Text and an image appeared instantly. "Scroll." Midway through the article she encountered a skeleton that her imagination easily fleshed out.

Add two pairs of eyes and it was a F'thk.

## CHAPTER 13

Swelk got no more rest that sleep-shift, her mind lost in a haze of odd findings and vague suspicions. So what did she *know*? That the so-called F'thk were robots controlled by the starship's performer passengers, with full cooperation of the officers. That the "symbols of galactic unity" the F'thk distributed everywhere were audiovisual bugging devices. That she was excluded from whatever the F'thk, and the Krulirim behind them, were doing.

*Why* these things should be true was a mystery, but as her mind grappled with the few hard facts, an unsettling theory took shape in her mind.

Testing that theory would require taking a big risk.

The product of a conformist species, Swelk had wondered if her revised Earth news filter would find any skeptical humans. She need not have worried. Her handicaps and social isolation made her more individualistic than any Krul whom she knew—but the cacophony of human viewpoints exceeded her ability to comprehend.

Once governmental pronouncements and mainstream networks were excluded, Earthly theories about the F'thk knew no logical bounds. Speculations ranged from the imminence of a supernatural catastrophe, if she correctly understood this English word "apocalypse," to an equally delusional expectation that the F'thk had crossed the light years looking for fresh meat.

Then again, end-of-the-world scenarios weren't so bizarre: nuclear tensions



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increased wherever the F'thk visited. Catastrophe, if not from paranormal causes, was an increasingly realistic prediction.

Still, she did not see how the hysteria in the alternate channels helped her. If she *could* contact any of these hysterics, she saw no reason why she *would*. They, like she, were on the outside of whatever was happening, trying to look in.

It did not help her sense of hopelessness that most Earthly information was beyond her reach. In the time it had taken the *Consensus* to reach Earth—a few months of relativity-dilated ship's time, several years of Earth time—the humans had migrated much of their information infrastructure from analog to digital technology. What the humans called their Internet apparently brimmed with information. The lifeboat computer had not been designed to interoperate with human networking protocols, alas, and she lacked the skills to expand its repertoire.

So the latest query had put her into noise overload. What she sought might not exist *anywhere* in this ocean of information. With little hope of success, she asked the computer to look again, this time saving only broadcasts with demeanor like several calm news readers that she identified *and* that expressed concern about the F'thk.

"What do *you* want?" Grelben grumbled.

"A word with Rualf," answered Swelk apologetically. Long gone were the days when the captain let her be alone on the bridge. She had waited to contact the actor until she knew he was here.

"It's not a problem, Captain," Rualf said soothingly. "I will talk with her."

She launched into a prepared speech about a recording he had once shown her. The new interpretation was not urgent; she sidled as she spoke until she was leaning against the horizontal working surface at the front of an unoccupied console. The underside of the ledge was her target.

Her deformed limb was near the workstation. The infirmity made most people uncomfortable; they tended not to look in its direction. For once, she welcomed their distaste. With two good limbs and the rim of the ledge to support her, she used the obscured limb to take a blob of sticky putty from a pocket between her body and the console. The blob was loosely wrapped in plastic sheeting to which the adhesive did not cling well.

Swelk flattened the blob against the underside of the ledge. The plastic, which peeled off silently, was returned to her pocket. She removed a spare pocket computer, which she pressed deep into the putty. The weak extremity cramping from such unaccustomed fine-motor activity, she stretched sticky stuff around the edges of the computer, the better to secure it.

"Are you about done?" asked the captain. "We have work to do here."

"Almost, sir." Her real task complete, she brought to a conclusion her rambling discussion with Rualf. "I'll be tending to the Girillian animals, if you need me."

Neither suggested that such a consultation was likely, which was fine with her. She hobbled to the cargo hold, where she had left her usual pocket comp. Her call to the hidden unit on the bridge went through silently, because she had disabled its speaker.

". . . a house in Vrdlek City," declared Rualf's voice. Expensive property.

"I prefer something in the desert," responded Grelben. "Perhaps shorefront on the Salt Sea."

Swelk bobbed her sensor stalks in relief. Her improvised bug worked.

The search program in the lifeboat computer was goal seeking. When the main channels that it monitored failed to locate information to Swelk's newly stringent specifications, the set of frequencies audited was expanded, then



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expanded again.

Swelk found herself reviewing a segment recorded from a history channel, puzzled that the computer had selected this. Mid-interview, she understood. The biography was of a famous scientist, who had ended her career as an inspirational teacher. Her most infamous student, it seemed, was a Kyle Gustafson, "the former presidential science advisor and resigned chairman of the American Commission on Galactic Studies." The camera lingered momentarily on an image of two men.

One man she knew from Rualf's spying device: the president. And that leader's science advisor had resigned in an undisclosed disagreement over the F'thk?

"Computer. Find out all you can about this Kyle Gustafson."

"What do you think, Stinky?"

The male swampbeast *humphed* contentedly. He pressed his head against the one-time broom with which he was now regularly groomed. Both swampbeasts, tentatively Stinky and Smelly, *loved* to be brushed between their nostrils. It was hard not to like creatures who took such joy from Swelk's ministrations.

*Humph* wasn't much of an answer to her question: why interact with humanity through the F'thk? The easy explanation was xenophobia: use of what she now recognized as robots to avoid direct dealings with the odd aliens. That seemed wrong—nowhere on her travels had she encountered Krulirim using robots to interact with previously discovered intelligent species.

She considered herself an expert in cultural variation, what little there was, among the Krulirim. Entertainers were one such variation. Certainly their willingness, even desire, to be personally visible, to be the focus of attention, was outside her people's mainstream. Rualf's troupe was clearly at the center of contacts with the humans—the F'thk were their robots.

Smelly *flumphed* in impatience. She also wanted to be groomed. "Almost your turn, baby." What advantage did the F'thk offer over direct interaction with the humans?

Smelly lowered her head to butt Swelk. The impact could have been much harder—it was only a request for attention. She patted her oversized charge affectionately. "Big beastie. What a big. . . ." She was suddenly reminded of a fact that familiarity had obscured—the swampbeasts loomed over her, as they towered over any Krul.

As humans would tower over any Krul.

The robots called the F'thk, however, were taller than nearly all humans. The F'thk "eyes" were very near the tops of their un-Krulchukor heads. There *was* an advantage to using F'thk rather than Krulirim to interact with the humans, and one that would appeal to the troupe.

Assuming the F'thk "eyes" were camera lenses, an unobstructed view for image capture.

"If a human group *did* spot one, surely it would be attributed to its enemy."

Swelk stiffened. She had been resting in an acceleration couch, sipping absently on a high-energy drink from the lifeboat's emergency stores. "Return to the start of that conversation," she ordered the computer. "Display text version."

Most bridge chatter turned out to be irrelevant, giving her hope that what she feared about this conversation was all in her imagination. Still, she believed that the inconclusiveness of her spying meant only that the most interesting discussions took place in another cargo hold of the *Consensus*, part of the ship to which the entertainers had free access but from which she was barred. There, presumably, could be found the controls for operating the F'thk.

"Enemy" was one of the keywords with which she screened for anything



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useful. After a momentary pause, a screen filled with text. She scanned past the pleasantries as Rualf joined Grelben on the bridge.

Rualf: Are our satellites all in position? Can they see in sufficient detail?

Grelben: Yes and yes. (Impatient tone.) As I said they would.

Rualf: And the humans do not know?

Grelben: Your people listen to the Earth recordings, not mine, but I would not think so. The satellites we deployed are radar-invisible; it would take very bad luck for the humans to physically see one. If a human group *did* spot one, surely it would be attributed to its enemy.

Rualf: Stupid freaks. (Laugh.) Lovely monstrosities.

Swelk read on, in fascination and horror. There could be no doubt: a conspiracy against the Earthlings *was* under way. Much about how the plot would unfold remained clouded, but its purpose was clear—and what she had most feared.

Rualf put it best. "Close-ups from our satellites of missile launches and nuclear destruction. Intercepts of Earth's media as they scurry in panic. Recordings from our bugs of their final moments." A gleeful laugh. "Yes, the humans respond well to their cues. When they blow themselves up, what a fine and *profitable* movie we will make of it."

"I've been counting on it," said the captain.

Light years from any authorities, Swelk had never felt so alone. Her species' at-best benign neglect for their less accomplished fellow sapients was awful enough. That was nothing compared to what she had discovered: the planned genocide of the humans in the name of profit.

And she had led the plotters to Earth.

She shut herself into her tiny cabin, clutching the sleep cushion with trembling limbs, smothering moans of despair in the bedding. Her sensor stalks slumped in abject misery against her torso.

What a fool she was. What arrogance to have thought herself a capable observer of Krulchukor culture. Now her ignorant presumption would destroy the most advanced civilization her people had ever encountered.

No.

She willed her limbs to relax, opened her eyes, focused her mind. Shame solved nothing. Realistically, nothing she could do aboard this ship would change anything.

She had to get to Earth.

### CHAPTER 14

There was a clue, but she was too excited to notice. That carelessness almost cost Swelk her life.

Animals once more fed and groomed, she had returned to the lifeboat to check on the latest data search. There was a wealth of information about Kyle Gustafson, his education, his career history, and sessions of the American commission on the Galactics.

The newest file was a video of the American president in loud telephonic argument with his unseen Russian counterpart, trading accusations about the recent mid-launch explosion of an American scientific satellite aboard a Russian rocket. So trivial a cause for so high-level an argument: the relationship between the countries must have become very strained. Kyle Gustafson took no part, standing silently in the background, but his height and reddish hair made him stand out.

Gustafson's mere presence had a staggering implication: his principled resignation had not separated him from his nation's leader. And *that* must mean Gustafson's concerns about the Galactics received some level of consideration within the American government.

As a loud boom echoed in the cargo hold, she realized she had failed to make a more pressing deduction. "Unlock this door!" shouted Captain Grelben.



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She *should* have wondered why this material had been located by her query. Like the war-strategy session that Rualf had shared, a shouting match between national leaders was unlikely to be waged in public. Which suggested that the meeting that so interested her had *also* been recorded secretly by one of Rualf's spheres. . . .

The shock of realization almost froze her. She had neglected to limit her last request to current broadcast intercepts, and her query must have enlisted the *Consensus*'s main computer. It was easy to guess what had followed: security software spotting the unauthorized data access and tracing the request to the lifeboat's computer, an alarm sent to the duty officer, a call to the captain, the realization of the lifeboat's proximity to the zoo that she tended without supervision.

"Swelk, you freak. Open this hatch *now*." A loud bang. Animals bellowed in confusion.

Cultural genocide was her species' horrific norm. *Physical* genocide was not. If the captain and Rualf had done half what Swelk now suspected, she could never be allowed to speak with the authorities on Krulchuk. Keeping her ignorant had been, in a crude way, a kindness—it preserved the option of letting her live. Discovery of Swelk's investigations eliminated her continuance as a viable outcome.

At least the plotters had made one small mistake: coming straight to the cargo hold in a rage without first looking up the hatch-lock override code.

Not that her actions demonstrated better forethought. "Lifeboat. Break communications with the *Consensus*." What next? Wasn't she trapped as surely as her swampbeasts? No, although she would have been had the *Consensus* been on the ground. "Can you launch without the cooperation of the main computer?"

"Yes. That is one of my emergency modes."

The pounding and shouting stopped. That meant no one expected her to open the door and someone had gone for the code. She had only seconds—terminals were all over the ship.

"Can you take me to Kyle Gustafson?" The off-limits information whose access had endangered her could also save her.

"Not with certainty. His current position is unknown, but the upload does include his residence and work locations." Swelk wasn't surprised: she had assumed the main computer had been tapped into the Earth's Internet.

She'd have to take the chance.

An unseen hatch crashed against a wall; she heard extremities slapping the cargo-hold floor and oaths of disgust at the animals' smell. A short hall connected the lifeboat bay to the cargo hold; a quick glance showed her that corridor hatch was ajar.

"Emergency departure. Close airlock. Launch."

The lifeboat and its automation could get her down to the surface, but she would be stuck where she landed—if she got that far.

She could only hope the confusion aboard the starship equaled her own. Her few preparations for escape to Earth suddenly seemed more fantasies than plans. "Lifeboat. No communications with the *Consensus*, nor with any of its lifeboats." Her mind's eye pictured a sudden windstorm in the ship she had fled, air streaming from the cargo hold into space through the suddenly gaping lifeboat bay, until the corridor hatch was sucked shut. Poor swampbeasts! "Was anything big blown from the ship?"

"No."

At least her hasty exit had probably not killed anyone.

What could they do beyond following her? She had a moment of panic on recalling the anti-spacejunk defense, then wondered if it would require reprogramming to fire at something moving *away* from the ship. That was pure specula-



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tion, but since she could do nothing about the laser, she may as well assume her theory was correct.

They would track the lifeboat all the way down, and there was nothing she could do about it. Still, observation of an escape attempt was something to which she had given thought: they could not see through clouds, and radar would not reveal what she did on the ground.

It was night in the United States. "Computer, show a weather map centered on Gustafson's home. Indicate nearby safe landing areas." Luck finally favored her; the whole region was clouded.

A landing site selected, she turned to other preparations. There wasn't much time.

The lifeboat broke through a dense bank of fog shrouding the forested and weathered peaks of the Allegheny Mountains. Landing radar and the onboard computer had delivered her with precision between two parallel ridges; the ship settled rapidly into a narrow valley. Gustafson's house was one valley away; the Franklin Ridge National Laboratory, to which Gustafson had returned in official disfavor, and the nearest town were two valleys further. The human's likeness, printed from one of the files whose download had exposed her, was in a pocket of the fresh garment she had taken from the lifeboat's stores.

She was belted securely into a padded couch, a squishy bag strapped into the seat next to her. Many shifts spent tending to her Girillian charges had cleansed her of all squeamishness; she doubted she could otherwise have gone through with the ploy with the sack. The bag was filled mostly with materials produced on the way down by the lifeboat's bioconverter. The synthesizer itself, portable of course, was in one of the tote bags she had pre-positioned in the airlock for her upcoming quick exit. Without synthesized Krulchukor food, she would starve in a few days—assuming she lasted that long.

"Landing in three-squared, three-squared less one. . . ." A console display showed an uneven surface rushing to meet her. Radar reflectivity supposedly proved that the lumpiness was vegetation. She would know soon, one way or another.

She struck with a thump, sliding and bumping along the uneven surface. A landing limb hit something hard. The skid snapped; the ship tipped and went into a roll. The craft finally jolted to rest, its leading edge crumbled around the bole of a tree.

"Open both airlock doors." She may as well confirm reports that Earth's air was breathable. Two doors cycled open; the rough landing had not damaged the lock mechanisms. She released her belts. In standing, she almost collapsed to the deck. The hard landing had badly bruised one of her normally good limbs.

This was taking too long. "Status?"

"Another lifeboat just launched."

One deduction of which Swelk was certain: she would not be chased by Krulirim. They had to expect her to abandon her lifeboat; her pursuers would have to leave their own craft. She took comfort that no human broadcast had *ever* shown a Krul. Surely they would not reveal themselves now.

And a lifeboat in pursuit, not the *Consensus*—appreciated, if not surprising, news. She had guessed the bigger ship would not dare to land in this rugged terrain. Launching a lifeboat had meant delay to retrofit teleoperation controls. While she had never seen a F'thk in person, she had watched videos of them among humans—few of the big robots could fit in a lifeboat.

The emergency stores included flares. She ignited one now, shoving the lit end into a drawer packed with flammable supplies. The fire blossomed, heat scorching her weak-limb sector as she hobbled to the open airlock.

Swelk looped the straps of two supply sacks around her torso. She couldn't



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make good time across the rough ground balanced on only her two strong limbs, especially with one now injured, and her foreshortened limb could never have supported that much weight. And now that crippled extremity had another problem.

The lifeboat had ripped a scar across the valley floor. She remained for two three-cubes of paces within the path of destruction, lest the bulging sacks she dragged leave too obvious a trail from the wreck. The fire grew hotter and brighter as she turned toward the alien woods. A sickening smell followed her. Then the flames must have reached the main fuel tanks, not emptied by the short trip from low Earth orbit. Her last thought, before light and sound and blast overwhelmed her, was a mixture of doubt and hope.

Would the stranger whose picture she carried come, or would she have to find him?

## CHAPTER 15

Another day older, but not visibly wiser.

Kyle Gustafson sat on his porch, his rattan chair leaning against the fieldstone front of the house. A vague yellow glow, barely discernible through the fog that overhung the mountains, was the only evidence of what the calendar declared to be a full moon. The telescope that he would otherwise have been using lay idle on its tripod.

He was contemplating—no, be honest: brooding about—the Moon, around which circled the enigmatic mothership of the equally mysterious Galactics. The enemy. On a clear night he could stare endlessly through the telescope at the great vessel, the unsubtle embodiment of science and technology far beyond Earth's own. Under the threat of that behemoth, humanity dared not even let it be known that a danger had been recognized. What could keep the aliens, were their indirect destruction of mankind to be foiled, from simply doing the deed themselves?

Key American and Russian space assets, including strategic early-warning satellites, kept dying. Individual F'thk explained confidentially that a Galactic faction was illegally assisting the other human side. The aliens hinted at a balance-of-power crisis within their commonwealth, and how humanity's competing authoritarian and democratic philosophies could affect that balance, should Earth be admitted. It was a plausible story for why F'thk factions would meddle on Earth—but the stories didn't jibe. And, oh yes: the pretty souvenir orbs that the F'thk distributed everywhere, supposed "symbols of galactic unity," turned out to be spying devices. No wonder the F'thk, in their whispering campaigns, knew just which geopolitical buttons to push. . . .

So the few people in the know playacted the descent into nuclear madness, posturing for the benefit of the ubiquitous galactic orbs, ever wondering whether today would be the day when an overstressed bomber pilot or submarine captain or missile-silo crew turned pretense into cataclysmic reality. Perhaps the aliens had already tired of waiting—the tactics that had almost brought the US and Russia to war were being tried now in Pyongyang, Islamabad, New Delhi, Beijing, Tehran, and Tel Aviv.

The *crack* of a sonic boom demanded his attention. He turned toward the sound, in time to observe a bright spark break through the low clouds and sink into the adjacent valley. From the light of the . . . exhaust? flames? . . . it did not *look* like an airplane, but he'd gotten only a glance. By the time he heard the crash, he was inside, dialing 911.

He had already plunged into the woods, flashlight in hand and cell phone in his pocket, when an explosion lit the sky.

At one level, the situation was clear enough, if tragic: crashed vehicle, fire,



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explosion. A sickening smell, not quite burning meat and gasoline, hung over the area. There was no sign of survivors, and the blaze was far too intense to let him approach the wreck. At least the forest was too wet to spread the fire. Judging from the violence of the detonation, he was almost certainly too late to help, but he half loped, half slid down the slope as quickly as he dared.

His cell phone chirped, but all he received was static. Not a surprise, here on the valley floor. If the call were from the rescue squad, they could follow the light of the fire. They were clearly on the way—the sirens were growing louder. After reaching his house, they would have to hoof it in, as he had.

What *was* he looking at? The burning craft no more resembled a plane up close than it had shooting across the sky. A F'thk vessel? He pivoted slowly, absorbing the whole terrible scene, a wide irregular gouge marking the craft's final careening course.

Trees swayed and branches bowed in the wind. Flames danced and twisted, spurted and died back. Light and shadow swirled around the valley in total confusion.

There! Perhaps twenty yards away, at the edge of the trees, something totally out of place caught his eye. It could have been the flames and odor operating on Kyle's subconscious, but his first impression was of an old charcoal barbecue grill somehow scuttling along on its three legs.

The sirens stopped; an emergency team would be over the crest and here in minutes. It looked like there *was* someone to be helped—and it was no F'thk.

The alien stood its ground as if pinned by the beam of Kyle's flashlight. The barbecue-grill comparison wasn't bad, even with a closer look. The limbs were jointed, though, unlike the tripod base of a grill, and the articulated . . . hand? foot? . . . at the end of one limb wore what could be a bandage. Three short stalks rose from the top of the torso.

Two sacks slumped on the ground nearby. The alien murmured softly, the sounds unintelligible—and a bag spoke. In English. "Are you . . . Kyle Gustafson?"

He was shocked, both by the question and that it sounded like a F'thk. A F'thk would *not* fit in that bag. A speech synthesizer and translator, then. "Do you need help? Why are you here?"

"Are you . . . Gustafson?" it repeated insistently.

"Yes." What was going on?

"Turn off . . . your light," ordered the alien. "Don't let . . . them see you."

He knew nothing about this species of Galactic, but judging from its harsh rasping and the pauses in the synthesized speech, it was gasping for breath.

Shouts of encouragement from the emergency team were getting closer. Beams of their flashlights shone over the ridge. He dimmed his flashlight and hurried to his unexpected visitor.

Trembling, the alien settled onto the ground. It pointed down the valley, in the direction from which its wrecked ship had arrived. The suspected bandage had a dark splotch, from which, as he watched, a large drop plopped. "They're . . . coming." A sonic boom soon proved it right. An intact version of what lay burning nearby broke through the clouds. "The F'thk."

"Do you need help before they get here?"

"I will . . . be fine. Don't . . . let F'thk . . . find me."

"But *why?*"

More tremors wracked the creature's body. Its sensor stalks dipped. "Keep . . . telling your . . . self it's . . . only a . . . movie."

## CHAPTER 16

Kyle had only seconds to make a decision, and he decided. The alien had sought him out specifically, and it must have a reason. He had to trust that it was a qualified judge of its own medical con-



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dition.

He carried the exhausted alien deep into the woods, walking always toward his flame-cast shadow, until the blaze ceased to light his way. Striding alone back toward the fire, he snapped occasional branches to discreetly mark the path. He made another trip with the bags of supplies.

The alien hidden, he walked parallel to the edge of the trees for a while, before switching his flashlight back on to emerge from the woods near the wreck. He called out a greeting to the rescue team that was scampering down the slope. The roar of a second spacecraft landing drowned out what could have been awkward questions.

Two F'thk emerged, shutting the airlock behind them. F'thk were difficult enough to tell apart in good lighting, as far as Kyle could tell differing only in slight variations of skin tone. He had no idea whether he'd met either in his days on the commission. The new alien's warning fresh in his mind, Kyle did nothing now to call attention to himself.

Easily seven feet tall, the F'thk towered over the human emergency squad. Both stood closer to the flame than the humans, even the protectively suited firefighters directing sprays of foam from canisters lugged over the ridge.

"How many were on board?" asked a firewoman.

"One." The F'thk who spoke did not directly face the wreck or the woman he answered. It wasn't being impolite—that was the F'thk way.

It's only a movie, the exhausted alien had said. An hallucination, surely—but if it were true, what a view the F'thk had. Behind Kyle, someone whispered, "It smells like burnt meat. I don't think the pilot made it out."

The F'thk also had acute hearing. "We will soon know," said one. Eventually the other added, "A terrible mistake. This lifeboat was ejected accidentally during routine maintenance."

Implausible on its face, but not impossible—like so much about the F'thk. Of course, Kyle knew something the F'thk didn't know he knew: about the injured Galactic hiding in the woods.

Under a sea of foam, the fire flickered out. A F'thk clambered aboard, charred wreckage crunching beneath his hooves. The firefighters exchanged glances: it was still *very* hot in there. They did not take into account its full-circle vision. "Do not be concerned. My kind are very heat-tolerant for short periods."

Several rescuers shone flashlights through the open hatches. Much of the cabin had been burnt beyond recognition. A shapeless, incinerated mass was still belted into what looked like an acceleration couch. The seats were far too small and of the wrong shape for F'thk. "Crispy critter," someone muttered.

The F'thk on the still smoldering lifeboat removed the presumed charred remains of his missing fellow. If it or its companion mourned his/her/its death, they kept those sentiments to themselves.

Then, as quickly as the F'thk had arrived, they were gone.

## CHAPTER 17

Swelk rested on a soft platform, her wounded limb freshly bandaged. The bed was in luxurious contrast to last night's trek over the mountain ridge to Gustafson's house. Her scientific detachment proved to be something of an abstraction: clinging to an alien—even the man she had sought out—took a constant effort of will. The experience of dealing intimately with Smelly and Stinky had again served her well.

One of her good limbs held food freshly synthesized in the portable bioconverter she had dragged from the lifeboat. Its preprogrammed capabilities included a full menu of Krulchukor cuisine.

"A useful gadget," her host said now. Kyle sat in a chair watching her. "Don't



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leave your home planet without one."

He did not realize *how* useful. "Given an organic sample, it can convert almost any biomass to any other. " She raised her bandaged limb, which still throbbed. "Such as skin, bone, muscle, and blood." She did not know the meaning of his sudden pallor and loud swallowing, so she continued. "My former shipmates would not rest until they found me, and any humans thought to have spoken with me could have been at risk."

"So you cut off your finger as a template for the synthesizer?"

Bit her digit off—there was no time to hunt for a knife. "And much of the emergency rations on board were the biomass it converted."

From what Kyle had told her, the robots had returned to the *Consensus* with "her" burnt remains: a perfect genetic match. Into the sack of synthesized tissues had also gone the garment she had worn onto the lifeboat, stained with Girillian feces. Grelben and Rualf would want to believe that she'd perished in the lifeboat, her body mangled and burnt beyond recognition in the crash. Swelk had made it as easy as she could for them to hold that belief.

Color slowly returned to Gustafson's face. "I think you should explain why you came here."

Swelk's host drank cup after cup of coffee, once she convinced him, on the basis of his first serving, that the strong odor was not offensive. Mildly odd, perhaps. She contented herself with tap water and a snack fresh from the converter.

Both were, for the moment, talked out. After comparing notes, each knew far more than before their meeting—and far less than they needed to know.

Keep telling yourself it's only a movie. What a concise explanation for the enigma that was the F'thk. What an indictment of Krulchukor ethics: that nuclear devastation of Earth and millions of human deaths were acceptable special effects for Rualf's film.

Any possible course of action was unclear. Krulchukor technology was advanced far beyond Earth's, beginning with fusion power, artificial gravity, bioconverters, and robotics. And the starship drive, of course. To Kyle's dismay, Swelk had only the vaguest idea how the drive worked. Her interests were in social, not physical, sciences. She thought she remembered once hearing that the drive tapped the base-level energy of a vacuum.

But she also brought good news . . . or if not good *news*, an upbeat inference. The Galactic mothership, that so unresponsively and impressively orbited the Moon, beyond human reach, could not possibly be what it appeared. Like the F'thk, it must be a prop, something improvised during the lunar stopover of the *Consensus*. A radar buoy embedded in a holographic projection, Kyle theorized—extremely impressive, and nothing humanity could reproduce, but *not* real. A special effect.

If Earth's scientists could prove there was no miles-across enemy vessel, it would mean mankind had only to deal with one spacecraft . . . and the *Consensus* was still in the habit, from time to time, of landing.

And anything that came to Earth, Kyle said, humanity had a chance to handle.

A helicopter was on its way. When it landed, Swelk would allow herself to be zipped into a duffel bag. Kyle would carry her aboard, and both would be flown in secrecy to the presidential retreat he called Camp David.

A small number of American and Russian officials already knew that the F'thk were not what they seemed. No more than a handful, Kyle had assured her, would be told that the F'thk were the teleoperated puppets of the xenophobic Krulirim—or that one very special, very brave Krul had defected to Earth.

One very frightened and guilt-wracked Krul, *she* would have said.

"Can I bring you anything?" He asked



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that a lot, and thanked her often for coming, as if *he* owed *her* something.

Swelk channel-surfed as they waited. The television evoked a simpler time, when knowledge of the humans had been hers alone, solitary and naively content on the starship's bridge . . . a time *before* she had brought here the threat of destruction. She stopped at the image of magnificent, giant creatures. "What are those?" The English translation came, muffled, from the other duffel in which were packed her few belongings.

"Elephants."

"I should like to see elephants, sometime." And nurture them. Who will take care of Stinky and Smelly?

"When it's possible, I will be delighted to escort you." A mechanical *thp-thp-thp*-ing sound intruded. "Swelk . . . our ride is almost here."

Swelk limped to the gaping duffel. Shunned by her own kind; now to be hidden from most of his. Humanity remained in terrible peril from her acts, the information she brought offering perhaps insight, but no help. Incredibly, she felt . . . *happy*. Something had changed for the better. What?

Keep telling yourself it's only a movie, she had told Kyle. She had known humans had movies, but seen very few. Her quote now to Gustafson from one of his country's greatest films was unintentional, but apt.

"This could be the beginning of a beautiful friendship."

## CHAPTER 18

"Chief of staff in the side pocket!"

A startled Britt Arledge, urbane elder statesman and confidant of the president of the United States, turned toward the unexpected shout. Rolling along parallel to the laboratory floor, at about his waist level and seemingly immune to gravity, was a basketball-sized, mottled white sphere. The orb submerged without impact into his torso before vanishing.

"Join me in my office and I'll explain." Kyle Gustafson led the way out of the crowded lab, past electronics racks and grinning technicians. He ignored his former boss' dour expression until they were behind a closed door. "The so-called Galactic mothership is like that demo."

"A cue ball with glandular problems? *This* is why you urgently summoned me from the White House?"

"Not a pool ball—a hologram." Kyle perched on a corner of his desk. "It explains a lot."

Britt found a chair. "Not to me."

"From the day the Galactics arrived, I've never liked the explanation for their mothership parking in a lunar orbit. A safety precaution, we're told, because it's antimatter-powered. Being a big prop, meant to intimidate us, is a much more credible reason for putting it where we can't easily examine it."

Britt crossed his arms across his chest, but said nothing.

"If the aliens, as they claim, do react antimatter with matter on their ship, it would produce tell-tale gamma radiation. Gamma rays don't penetrate the atmosphere, so to maintain their lie, they can't allow high-altitude gamma detectors. That's why, shortly before announcing their arrival, they destroyed the space shuttle carrying a new gamma-ray observatory to orbit. That's why they exploded the Russian rocket with the back-up instrument." Kyle waved off an objection while Britt was still formulating it. "No, I haven't confused an inability to measure with proof there is nothing to *be* measured. We've surreptitiously flown gamma-ray detectors on weather balloons. The data we can collect that way are nowhere near as good as the lost observatories would've gotten, but we've seen *no* unexpected gamma radiation from the Moon's vicinity."

"Anything else?"

The untimely on-orbit deaths over the past few months of older, less-capable gamma-ray-sensing satellites was only cir-



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cumstantial, not conclusive. "Recall what we've learned from Swelk." He glanced reflexively at his office safe, wherein sat a copy of the CIA's most recent Eyes Only report on the alien's ongoing debriefing. "You know I've been perplexed by our observations of the F'thk. It's no wonder I've been confused by their 'biological' indications . . . Swelk says they're robots. I'm convinced that the mothership, like the F'thk, is a special effect. Swelk said the starship from which she escaped spent time on the Moon before coming to Earth. That's a ship we *know* exists—we have the cracked runways to prove it. A lunar stopover gave them the opportunity to set up lasers to project the hologram—like my cue ball, only much larger. Of course the Krulirim need lots of lasers, and big ones at that, to simulate a mothership orbiting the Moon."

"Of *course*."

Kyle winced at the sarcasm. "You disagree?"

"I'm unconvinced. Say it is an enormous hologram. Why would a hologram be visible to radar?"

Kyle nodded. "It wouldn't. But the Krulirim could have easily put a radar buoy in orbit around the Moon, a buoy around which the hologram would be centered. The buoy would dynamically generate a radar echo in response to any incident of radar pulse."

"And this buoy, naturally, would be visibly obscured by the hologram." Britt stood.

Such a buoy, even unobscured, would likely be too small to be seen from Earth, even by the Hubble. Kyle kept that complication to himself as an unnecessary distraction. "It's not as if we lack evidence. We know the aliens destroyed the Russian's Proton launch, and how they did it. The manner of that rocket's destruction matches everything we know about the *Atlantis* disaster. We know the aliens are filling our cities with spying devices. And an ET defector, looking nothing like the 'official' F'thk emissaries, practically landed in my yard. *She's* proof."

"I concede alien hostility, and I don't forget for a moment it was your skepticism which led us to that fact. But none of the evidence relates directly to the mothership. Maybe it has great shielding, or the antimatter reactor is shut down for maintenance. Maybe the ETs *are* lying, but only about using antimatter. Proving or disproving such ideas is more in your bailiwick than mine.

"I'm going to propose an alternative scenario, one drawn from the skills *I* use every day." Britt met Kyle's gaze. "It's a much simpler explanation than yours. We have only Swelk's word for it that she was defecting.

"Did you ever consider that she may be lying?"

A riddle wrapped in a mystery inside an enigma . . . Winston Churchill's description of Russia fit the baffling Galactics at least as well. And the mad scientist for whom she was waiting.

Darlene was a career diplomat and the senior-ranking State Department representative to the American commission that routinely coordinated with the Galactics. None of that experience had prepared her for cloak-and-dagger operations. That Kyle was no more plausible than she to play agent only deepened the mystery.

Searching the crowded Metro parking lot, Darlene's head swiveled to and fro in a manner she felt sure must somehow look furtive. Per Kyle's odd request, she wore a head scarf and large-lensed sunglasses.

A nondescript, boxy sedan pulled up to the region of curb labeled "kiss and ride"; the passenger-side window slid down. The mad scientist was behind the wheel. "Can I give you a lift?" Kyle asked.

Darlene got in and removed her scarf. "Government license plates. A motorpool vehicle?"

"Swapped for my car inside a mall's



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covered parking garage. Any overhead observers are *very* unlikely to know where I am." The clearly implied watchers were Galactic. He merged expertly into the heavy traffic streaming from the commuter lot.

"And per your invitation, which you so interestingly and oddly had FedExed, I'm meeting you at a station that required me to change trains in an underground Metro stop. That makes my whereabouts equally disguised." She tucked the scarf into her purse. "Where are we going that's so secret?"

He pulled onto a highway, heading northwest into rural Maryland. "Let's just say a pleasant drive in the country."

"A few days ago, a Galactic lifeboat crashed and burned near your house. Now you're playing spy. I doubt those situations are unrelated."

"We'll see."

She twisted her neck to examine a loosely closed box on the back seat, a container from which emerged scratching sounds and soft thuds. "What's in there?"

"Kittens for a friend. She's from out of town, and misses her own pets." He pointed to a sunlit wooded hillside aglow in red and gold. "Check out those leaves." He turned onto a shoulderless two-lane country road. She gave up with a sigh, silently admiring the fall foliage until after almost thirty minutes, Kyle pulled into a small graveled lot.

Behind a low, hand-stacked fieldstone wall, amid a sea of fallen leaves, sat a picturesque white farmhouse. The sign dangling by two chains from the crosspiece of a wooden post declared, simply, "Valley View - 1808." She guessed that was the construction date rather than an address.

Valley View could have been a bed-and-breakfast . . . except for the four alert-looking men who paced nearby. One watched the new arrivals, one studied the road, and two peered intently into the nearby woods. From the corner of an eye, she saw Kyle observing her, a slight smile on his face. Wondering how she'd react to a B&B?

The crash of the Galactic lifeboat could not have been kept secret. A whisked-away survivor was another matter. She turned to Kyle. "A CIA safehouse, I presume."

Swelk was sunken deep into what she'd been told was called a beanbag chair, the single piece of Krul-friendly furniture in the house. There were engine noises outside. Footsteps in the front hall revealed that one of her guardians—or were they captors?—was striding down the front hall. The unseen door opened with a squeak. The mutters of human conversation were too faint for her pocket computer to translate.

Perhaps only a change of shift. Leaving one stalk to monitor the entrance to her room, her attention and two sensor stalks remained fixed on the flat-screen television that hung on the wall. The only signal source was something called a DVD player. There was little else to do between questionings. Her lack of access to Earth's broadcasts and its Internet shouted distrust.

Knowing what her people were doing, she could not fault her hosts for their suspicion.

"Kyle!" she yelped in delight as her new friend entered, box in hand. She struggled out of her hollow in the beanbag. A human female accompanied Kyle, her eyes opened wide.

"Swelk, this is my friend and colleague Darlene Lyons, from the American State Department. Darlene, I'd like you to meet a *real* Galactic."

Standing, the chimerical alien rose only to Darlene's waist. Its torso was a flattened black spheroid perched atop three spindly legs. No, make that *limbs*—the appendage Swelk had extended in greeting was as much an arm as a leg. It had a clearly prehensile end, suggesting a cluster of three opposable hands, each with three opposable fin-



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gers. Three objects vaguely suggestive of untrimmed rubbery celery stalks protruded from the top of the body. Two stalk tips seemed to be studying her. "I am pleased to meet you," said a box on the counter, speaking moments after the ET emitted a burst of vowel-less and incomprehensible sound. "I am called Swelk, from the Krulchukor ship *Consensus*."

She dropped in shock into a nearby chair, rationalizing that it was diplomatic to come closer to the little alien's level. Kyle, thankfully, interceded to bring her quickly up to date. Swelk's defection and the intentional destruction of her lifeboat to cover her escape. The xenophobic tendencies of the Krulirim. The long-extinct fossil species from Krulchuk serving as the prototype for the tall centauroid robots presented to humanity as interstellar emissaries: the F'thk. The giant mothership orbiting the Moon a mirage meant to intimidate. The movie company aboard the *Consensus*, conspiring to provoke nuclear war as the ultimate special effect.

Her mind whirled. "So there is no Galactic Commonwealth?" she finally managed.

"Not known to my people," answered the alien's translator.

Over the alien's head Kyle quizzically raised an eyebrow. The alien's third eye stalk could surely have seen the gesture, but would the ET have understood it?

His hopefully subtle signal was unnecessary. It had become clear that the F'thk were lying . . . why should she not be as skeptical of this new alien? Swelk's whole species was until now undisclosed.

Squealing, Swelk flexed a sensor stalk toward the cardboard box Kyle had set down. A coal-black kitten, not yet grown into its ears, was bursting through the flaps. Arching its back, the cat fluffed up its fur and hissed at the alien. "What's *that?*" yelped the translator.

As Kyle tried to calm the feline, Darlene worked scenarios in her mind. That the Krul was being truthful was only one possibility. Ostensibly friendly F'thk had privately told Darlene and other human diplomats that the many-specied Galactic Commonwealth was riven by factions. If that much of the F'thk story were true, Swelk could be an agent, planted by one side. If so, to what end?

"It's a baby animal, a young cat." Kyle offered a sack of kitty treats to the alien. With his other hand he stroked the kitten soothingly, as Swelk now cautiously extended an extremity. The black cat sniffed daintily, then licked the offered treat. A loud purring began.

If Swelk were telling the truth, the aliens *could* be vulnerable when their single starship landed at one Earth city or another. But if she were lying . . . then the ship they might attack would be a mere landing craft from a miles-wide behemoth in lunar orbit. What retribution would the ETs exact?

And if there were, after all, a Galactic Commonwealth, a sneak attack on its emissaries was likely, at a minimum, to disqualify Earth's application. Without pretending to understand the interspecies politics of the supposed Galactics, Darlene could understand some aliens opting for the familiar. Maneuvering the humans into discrediting themselves could be an easy way for one faction to maintain the often-comforting *status quo*.

Kyle released the kitten; as it sidled towards the alien, still holding a treat, a second kitten, this one a gray tabby, scrabbled from the box. With a manipulation no human arm could have duplicated, Swelk's extended limb extracted and extended another morsel without dropping the sack or the piece already being sniffed by the black cat. "What are they called?"

"You can name them," answered Kyle.

He hadn't brought her here to play with the kittens, cute as they were, nor had he lightly disclosed what must be an *extremely* closely held secret. So why *was* she here? As an unofficial second



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opinion, perhaps. As different as were their professions and interests, she and Kyle shared what she considered a healthy dose of skepticism (which, Darlene had good reason to suspect, her Foggy Bottom associates more often considered an annoying contrariness).

The respect was mutual, and the opportunity for a career diplomat intriguing. She scooped up the curious tabby, for which the antiques-furnished salon was entirely unprepared. "Swelk, I'd like learn all about your people."

## CHAPTER 19

From deep within a beanbag chair—Kyle had now brought one for most rooms of the building—Swelk watched two more curious and dissatisfied visitors leave. Humans under stress, she knew from both intercepted movies and her short time on Earth, paced to and fro. Krulirim in like circumstances also moved, in their case—naturally—always in circles.

Swelk's present immobility was willed. Her lame leg always ruined the perfection of her loops; she'd endured enough ridicule about her deviancies to have learned long ago how not to evoke more. Seething though she was in unexpressed frustration, a fragment of her mind laughed at the foolishness of maintaining self-discipline in front of the bilateral humans.

"May I join you?" asked Darlene Lyons from the doorway. She was at the house much more often than Kyle.

Why bother, thought Swelk. So far today she had failed dismally to answer questions about the engines of the *Consensus*, the numbers and capabilities of its anti-meteor lasers, and the range of its lifeboats. Of the lifeboats she had known only that the reach was less than interstellar. She had abruptly ended the last session, about "military capabilities," when she realized what motivated the two men's inquiries: a possible assault on the *Consensus*. Despite Swelk's abuse by its passengers and crew, thoughts of revenge had not motivated her hasty departure.

"Of course," Swelk waggled two digits in feigned welcome. The gray tabby, now named Stripes, leapt clumsily onto the beanbag chair. It toppled against her, and almost immediately fell asleep. The fuzzy little thing, all legs and ears and impossibly soft fur, could not have been more different from a Girillian swamp-beast—and the kitten reminded Swelk achingly of her abandoned charges. She would *not* cause them more suffering. "But I won't help Earth attack my former shipmates."

Darlene's cheeks reddened, a reaction whose meaning Swelk could not penetrate. "I have no desire to become a radioactive extra in a Krulchukor movie. What would you propose we do?"

Swelk's sensor stalks drooped in sadness and shame. The passengers and officers of the *Consensus* were eager to sacrifice the most advanced race her people had ever discovered. Would the plotters accept disappointment, meekly heading home if their plans were widely disclosed . . . or would they find new means to produce the same result? Rualf's special-effects wizards had already produced the robotic F'thk and the illusion of a gigantic Moon-orbiting mothership. Did she dare gamble they could not find a way to goad any Earth country into attacking its national rival? From newscasts Swelk had surreptitiously watched in her lifeboat hideaway before her escape, it seemed that counterstrike after counter-counterstrike would inevitably follow the first hostile launch.

And what if the filmmakers' attempts to fool Earth into a photogenic self-destruction *did* fail? Would Rualf and Captain Grelben, their dreams of vast wealth dashed, lash out at Earth in anger and disappointment? Swelk felt certain that an unsuccessful attack on the *Consensus* would draw an enraged response. Either way, as the morning's earlier visitors had made her realize, she simply did not know what danger the Krulchukor ship



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represented. There was no doubting from the humans' questions that they were concerned.

And *she* had led Rualf and Captain Grelben here. The exile's sensor stalks collapsed in withdrawal. The suddenly limp tendrils lay draped across her torso, obscuring her vision and muffling her hearing.

"Swelk!" called Darlene. "Are you all right?"

Swelk roused herself with a shake, her sensor stalks snapping painfully erect. "I am far from all right, but I have only myself to blame for that.

"And as for your previous question, I have no idea what we should do."

Kyle watched Swelk watching the kittens from the comfort of the beanbag chair she had towed into the dining room. Blackie and Stripes—*there* were two unimaginative names . . . were all Krulirim so literal?—were tussling for no obvious reason, their tiny mouths opening repeatedly in meows either silent or too high-pitched for him to hear. From time to time a cat forgot what she was doing and pounced on the disheveled fringe of the oriental rug on which they played.

The little alien had two sensor stalks pointed at her pets; the third was timeshared between Kyle and routine scanning of the room. One needed little time with Swelk, he thought, to deduce where the ET's attention was focused. He glanced at his wristwatch and sighed inwardly. His impatience was unfair, and he knew it. One debriefer after another grilled her most of the day, every day. He had to allow her an occasional mental break.

Those feelings of tolerance did nothing to expand the hours in Kyle's day. Well, he hadn't grown up with pets for nothing. After a while, he took the laser pointer from his pocket, waving it to make a jiggly red dot beside the kittens. They immediately stopped wrestling to chase the spot around the room. The hunt became a stakeout at the hall-closet door beneath which the laser dot had vanished. They were likely to stay there, staring at the gap under the door, for some time.

With the kittens quieted down, he tried to get Swelk back to business. "I'd like to talk some more about the bioconverter."

Success: she favored him now with two sensor stalks. "What else is there to say? I put organic material in. I take different stuff out."

"How does it work?"

"Here is the on-off button. I can pick what I want made from the list in this display, or insert a sample here. I speak how much I want. Raw material, when needed, goes into this chute. Anything it can't use is emptied here. Food is deposited in the final compartment." She flicked, three times, all the digits of one limb. He took it as a sign of annoyance. "I have told you, and others, all of this before."

The day was overcast; the illumination from the window was gloomy. He pointed at the chandelier over the dining-room table. "Would you mind if I turn on the lamp?" Standing without waiting for an answer, he was surprised at the response he got.

"I do not like your lights. They make me jumpy."

"All right." He sat back down. Kyle knew people who got depressed in the winter from too little sun. There was even a medical name for the condition: seasonal affective disorder. In Swelk's case, of course, the ambient light wouldn't improve with the months-distant lengthening of the days. Renewed sympathy for the solitary alien washed over him. He tamped down the feeling—what Earth needed now was information. "I understand the controls for the bioconverter. My question is different. What happens inside to make it work?"

The alien hesitated. "Chemicals are broken apart. The pieces are recombined into new chemicals. Maybe there's



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a computer inside to control it."

Foiled again. Kyle's certified-evidence-free theory was that the bioconverter employed nanotechnology: self-replicating molecular-sized machines to manipulate atoms and molecules. Nanotech was conceptual at best in some of Earth's cutting-edge labs; any clues to its practical implementation could be priceless. The darker side of Kyle's speculation, if he could substantiate it, would be a whole new reason to fear the possible wrath of the Galactics. Imagine flesh-eating bacteria with attitude. . . .

*Quit it, Kyle.* It seemed he would be getting no hints from Swelk. Alas, her failure to answer these sorts of questions implied nothing about the truth of her story. How many people did he know without a clue how, say, their TV or refrigerator worked?

Speaking of refrigerators, and probably why he thought of one, he wouldn't mind a cold soda. Retrieving a can would provide a few minutes in which to exorcise his frustrations, since the safehouse was presently without a functioning cooler.

No one had seen a way to tell whether Swelk's bioconverter or computer had undisclosed capabilities . . . such as communicating with the ship from which she had, or claimed to have, defected. Even if her story were accepted—personally, he believed her—the danger would remain that hostile Krulirim could eavesdrop through her stolen equipment.

One of the few things he truly *knew* was that F'thk spying devices, the Galactic orbs, used microwaves. That Swelk's gear, *if* it had a communications mode, also exploited the electromagnetic spectrum, seemed like a good bet to take.

In terms of suppressing radio-based communications, stashing the alien in an existing radiometrics lab would have been ideal—but it would have sacrificed secrecy and discretion. Instead, the isolated one-time farmhouse had been hastily "remodeled" before Swelk was moved in and her debriefing begun in earnest.

The farmhouse's walls were newly spray painted with an electrically conductive pigment. Rolls of fine copper mesh lined the attic floor and cellar ceiling. Copper screens now covered all windows and doors. Everything was interconnected and grounded. Kyle had personally tested and blessed the finished product: an unobtrusive electromagnetic shield.

In the greater scheme of things, it was a small matter: a too casually draped dropcloth had let some of the sprayed conductive paint drift into the guts of the refrigerator. Plugged back in after the alterations were finished, the motor, obviously shorted out, had fried itself. It appeared that the owner previous to the CIA was one of those frugal fools who used pennies as fuses.

"I'm going to the trailer for a soda," Kyle told Swelk. "Can I get you anything?"

"I will stay with water from the kitchen tap."

The back door banged shut behind Kyle. The Airstream trailer to which Kyle now headed sat discreetly behind the house. Originally deployed as a communications station—the safehouse's shielding also blocked the agents' cell phones—the motor home was now most prized for its tiny refrigerator. He waved at an agent behind the house on a cigarette break, got a Coke, and returned.

"Sorry for the interruption." Blackie and Stripes were still waiting for the "mouse" to emerge from the closet. "About the bioconverter again; how is it powered?"

Swelk had gotten a glass of water during his absence. She had to climb to the counter to operate the sink. Instead of answering, she and her computer traded untranslated squeals. Finally, her computer said, "The translation program does not have the word I want. Maybe your technology does not have this capa-



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bility. Some of the material I feed into the bioconverter is used to make the electricity. The energy is stored in something like a battery."

It sounded like a fuel cell, although a much better and more flexible design than any Kyle knew. That itself was interesting, but another opportunity had just presented itself. "Does your computer have notes about how the bioconverter itself works? Maybe even a design?"

More squeals and whines. "I am sorry. No."

Had he imagined a pregnant pause after 'sorry'? Or was Swelk short of breath, as so often happened? She'd told him that Earth had more $CO_2$ than home. "Why not?"

Swelk's sensor stalks dropped. Body language for regret? Or for evasion? "I was unprepared for my escape." Pause. "I left the *Consensus* when my spying was discovered. My computer was mostly filled with movies." An even longer pause. "Sorry."

Another plausible explanation . . . for another aggravating roadblock. Britt's skepticism had one more data point of support.

"Cold War II: First Casualties!" screamed the headline.

A well-read *Washington Post* had been left on the table of the NASA conference room in which Kyle waited for Britt Arledge. Goddard Space Flight Center, in Greenbelt, Maryland, was a short drive from the White House—and the sprawling, campus-like complex had several electromagnetically shielded labs for the routine assembly and check-out of scientific satellites. A get-together here offered reasonable assurances against Galactic eavesdropping without drawing alien attention to Kyle or the federal lab at which he officially worked. Proximity to the District was simply a bonus.

Despite the inch-tall banner, details on the clash were sparse. There had been a brief but deadly dogfight over the South China Sea between Russian fighters based in Vietnam and carrier-based American fighters. Accounts differed, of course, as to who had fired first. Moscow claimed its planes had been on a routine exercise, and their approach to the carrier task force was no more sinister than hundreds of similar events over the years. Washington said a targeting radar had been detected.

What *was* clear was that three SU-22s and two F/A-18s had been splashed. Two pilots, one Russian and one American, had failed to eject. Both were missing and presumed dead.

"Dirty business, that."

Kyle looked up at the sound of Britt's voice. "That it is." The wonder was that more incidents and more deaths had not occurred as the tensions between the United States and Russia kept rising. It was, to the very few who knew, a simulation of a nuclear crisis . . . but that pretense of hostility could turn real enough at a moment's notice. Too many nerves were stretched taut. Too many weapons could be loosed on a moment's notice.

He flung down the newspaper he'd been studying. Given what Swelk had told them, did Earth's nuclear powers need to continue the disaster-prone deception? He was trying to work that through in his own mind. "We'll be meeting down the hall."

Nodding, Britt followed Kyle along a road-stripe-yellow corridor to the shielded privacy of a cavernous, multi-story satellite-assembly lab. Hands clasping the steel-pipe railing of a catwalk, Kyle felt free to speak his mind. "Is the president prepared to tell the Russians about our defector? We need to stop the madness before something even worse happens."

Britt's nostrils flared slightly, as visible a sign as he ever gave of disagreement. "I'm not yet convinced that she *is* a defector, and not an agent. Why are you?"

It was the debate they kept having. Nothing in Swelk's ongoing CIA debriefings had revealed any inconsistencies in her story, nor had the little ET shared



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anything irreconcilable with Kyle or Darlene. A large part of that consistent story, unfortunately, was wide-ranging unfamiliarity with her species' science and engineering. That an intelligent member of a modern society could be ignorant of its technologies—Britt cheerfully admitted that he was without a clue how a radio worked and what kept a plane in the air—settled nothing.

The more cynical CIA debriefers went further, speculating that the very absence of minor loose ends in Swelk's story suggested a fabrication. Kyle thought he'd squelched that insinuation, as a groundless extrapolation to the aliens of a human foible. Who was to say all Krulirim didn't have a flawless memory for detail?

This was no trivial difference of opinion; humanity's future teetered on the fulcrum of the choice they must soon make. Kyle's knuckles were white from pressure, as he fought to control his emotions. "No amount of contradiction-free interrogation is going to overcome your doubts. Ironclad proof of her story, if Swelk is telling the truth, is on the *Consensus* . . . which, as you know, the ETs won't allow us aboard." The few attempts to hide bugs on the aliens or their equipment had been met with uniform failure and angry F'thk denunciations. The president himself had banned further attempts as too dangerous.

"And yet," Britt flashed a momentary smile, "you asked that we get together."

"True." Kyle extracted two glossy sheets from the manila envelope that he'd carried tucked under an arm. Each page bore an image of the Moon, its cratered landscape unmistakable. "Take a look at these."

Britt's eyes switched back and forth between pictures. The tiny timestamps in the corners of each differed by only milliseconds. "They're the same scene, right? The left one shows much more detail."

"The higher-resolution shot is an optical image. The other is a computer reconstruction from a reflected microwave pulse." Kyle suppressed an urge to discuss just how much computation had been required to generate the latter image. "We adopted technology used to predict the stealthiness of airplane designs without having to build them first."

He took back the images before handing over a third. The new picture showed the supposed Galactic mothership. Less than half a hemisphere was visible, the rest an inky blackness. A similarly divided lunar landscape provided a dramatic backdrop. "Sunlight is striking from the side, obviously."

Britt tapped the photo. "What's this dark spot?"

"Good eye—it's a shadow."

"Of what? It must be something big."

"A hangar. Their utility spacecraft, the ones that never land on the Earth-visible side of the Moon, emerge from and return to that bay. Most of the time the door is closed." One of the just-mentioned auxiliary craft was also in the image. Kyle was aware, although the still frame didn't support the knowledge, that the smaller vessel had just exited the hangar.

Britt looked at him shrewdly. "But you claim not to believe in this mothership. Swelk says it doesn't exist."

"That hangar for the auxiliary craft would be a thousand-plus feet deep. We can calculate that depth from the geometry of the shadow." The previous microwave observation had shown craters much shallower than that. With a flourish, Kyle offered a final image. "Now look at this."

This computer-reconstructed microwave image, its timestamp again well within a second of its optical analogue, did not show any auxiliary craft. And the Galactic mothership appeared only as a featureless sphere.

### CHAPTER 20

"The American and Russian navies today separately announced the apparent



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loss of a submarine in the North Atlantic. Few details, and no official theories as to the cause or causes of the incidents, are available. French and Spanish seismologists recorded events in the region consistent with underwater explosions. Deep submergence rescue vehicles are being rushed to the area by the two navies, but hopes for any survivors are slim.

"The frigid state of relationships between these nuclear powers, and the proximity of their lost submarines, suggest that the disasters might in some way be linked. This is an inference about which spokespersons of both sides declined comment."

*—BBC News Service*

They were sounded out, nominated, haggled over, and finally agreed upon in the most casual of contexts: huffed conversations between joggers; "chance" encounters of smokers in the shadow of the Pentagon; a *tête à tête* between parents at a kids' soccer match; walks in the woods surrounding Camp David; a half-dozen other innocent-seeming meetings in venues previously confirmed to be free of Galactic orbs and potentially compromised Earthly comm gear. The disappearance for even a few hours of the principals—the president, the director of the CIA, the secretary of defense, the secretary of state, the national security advisor—could trigger who knew what response from nervous Russians or inscrutable aliens. The five who were now gathered, in the most rustic of surroundings, would hold the debate their principals could not.

Kyle had volunteered his sister's remote Chesapeake Bay cabin. Darlene had driven from the District with him; the others arrived soon after, two in separate cars and one in the motorboat now bobbing alongside the cabin's rickety pier.

The dragged-indoors picnic table around which they met, a tarp covering the carved doodles of Kyle's young nieces, had never seen such august company. Erin Fitzhugh was a CIA deputy director, the terseness of her official resume implying a long history in covert operations. USAF Lt. Gen. Ryan Bauer—former B-52 pilot, Gulf War veteran, ex-director of the Ballistic Missile Defense Organization—was presently on staff to the Chairman of the Joint Chiefs. Kyle was a widely respected physicist and the director emeritus of Franklin Ridge National Lab; more importantly, he was the one-time (and still unofficial) science advisor to the president.

Darlene's credentials, she felt, were the least impressive. A long-time foreign-service officer and now a deputy undersecretary of the Department of State, she was here to represent the diplomatic perspective. Britt had assured her that no one had *ever* considered holding this summit about the aliens—which was all that the invitees had been told about the gathering's purpose—without the first diplomat to see through the facade of F'thk good intentions.

The president's chief of staff was the final member of the small group, there to direct discussion of the still-undisclosed topic and report back to his boss. Of all the participants, Britt had the highest public profile. Official Washington thought he was down and out with this fall's virulent strain of flu.

Kyle was indulging some odd urge to play host before the discussion kicked off. As Darlene gave him a hand in the kitchen with cold sodas and salty snacks, Bauer and Fitzhugh rehashed the North Atlantic incident. The working theory was an undersea collision between the Russian attack sub that had been trailing an American boomer—ballistic-missile sub—and the American attack sub too closely following the unsuspecting Russian.

The details didn't parse at first—Darlene's job at State dealt with human rights and fostering democracy, not arms control and nuclear deterrence. A chill washed over her as—through whis-



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pered consultations with Kyle; a presidential science advisor's purview certainly did include nuclear matters—she came up to speed.

Dissolution of the USSR had removed several outward-looking land-based radars from the Russian missile-defense network, gaps that became ever more troubling as the Galactics systematically destroyed early warning satellites. In predictable parts of every day, the Russians were effectively blind to submarine-launched missiles along two narrow corridors. Attack subs like the one the Russians had just lost sought to find and secretly track the American boomers. In case of hostilities, destroying a boomer before it launched would scratch twenty-four ballistic missiles, each with up to twelve nuclear warheads. American attack subs, in turn, silently stalked their Russian counterparts, ready to preemptively take out a Russian hunter. The vulnerabilities created by the Russian blind spots made hair-triggers inevitable . . . and incredibly dangerous.

The doomed subs had followed a boomer into one of the Russian blind spots.

"We've *got* to step back from the brink," Darlene blurted from the kitchen. "We're too close to disaster."

The national-security pros exchanged a look that said, "amateurs." Erin Fitzhugh cleared her throat. She was more one of the guys than most of the guys. "We and the Russkies have half a century's practice at dancing on the edge. Now, whenever our tensions show signs of leveling off, the F'thk, or Krulirim, or whoever the bug-eyed monsters are, turn their attention to the less experienced nuclear powers. Would you feel any safer if the damned ETs were working their magic on the Pakistanis and the Indians? Israelis and Iranians? *I* sure as shit wouldn't—their command-and-control systems are all bad jokes."

Pretzels flew as the diplomat undiplomatically slammed a tray onto the picnic table. "Are you saying the Atlantic incident was staged?"

"All *too* real," interrupted Britt. "Entirely real, and for the reasons Erin has articulated. We don't dare encourage the aliens to put more effort into manipulating the less seasoned members of the nuclear club. And unless we keep the military in the dark, we can't hope to keep secret our knowledge of concealed ET hostility. So the operative question is: when, if ever, do we take on the aliens?

"That, ladies and gentlemen, brings us to the purpose of our meeting. The president is considering telling President Chernykov about our alien defector."

Stripes, who had been pouncing alternately on her sister, the fronds of a fern rustling in the draft from the fireplace, and her own tail, skidded to a halt with a sudden confused expression. After a moment of whatever passed for consideration in her young brain, the kitten skittered off in the direction of the nearest litter box. She thundered up the worn wooden stairs making noise in total disproportion to her size.

Swelk almost hoped the kitten would be too late. Tending to the Girillian menagerie had begun as a ploy; caring for them had become ennobling. She yearned to regain that quiet satisfaction of being needed. There was a flurry of unseen digging noises, and then Stripes returned at full gallop to the salon. With a leap and a mid-air twist, the cat was off in pursuit of something only it could see. Swelk waggled her sensor stalks in amused confusion . . . the thing Kyle called a poltergeist baffled her translation program.

With thoughts of him, her momentary good mood vanished. The human to whom she felt closest had not stopped by in two days. And it was not only Kyle—none of her most frequent visitors had come by. Even an alien newly arrived could tell from the demeanor of her guards that the substitute questioners were of lesser status than those who had disappeared.



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What Kyle and the others were doing, she could not imagine.

"It was clear-cut enough to me," said Kyle. He didn't entirely feel that way, but the other summiteers were erring in the opposite direction. "Either Swelk is a defector or she's not. Which do we believe?"

Everyone began animatedly speaking at once, stopped, then all started up again. On the next random retry, the ex-spy got the floor. "The ET could be a real defector—and delusional. She could be entirely sane and sincere, and unaware that she's been filled with disinformation. She could be lying through whatever she uses for teeth, for reasons fathomable only to celery-eyed monsters, and still reveal . . . with whatever encouragement is appropriate . . . incredibly valuable information. We need to understand her motivations to have any hope of making sense of anything she tells us."

From nowhere came a memory of Swelk dangling a scrap of yarn above leaping kittens. "Delusional? A secret agent? Erin, have you ever actually *met* Swelk?"

"No, by intent." Fitzhugh impatiently flicked a potato-chip crumb from the table. "My people have. I talk to them; I read their reports. I'm objective. It's the *professional* way to handle supposed defectors, even when the stakes aren't so high."

Ryan Bauer popped open another Coke. "It's just too convenient that nothing in Swelk's story can be confirmed—short of making what could be a suicidal attack on the F'thk vessel. She claims she's some kind of outcast and dilettante social scientist, excusing her not knowing anything helpful. The lifeboat she came down on is melted slag. Her computer can't be experimented with, because it contains her translator. Her so-called bioconverter can't be fiddled with because that would put at risk her food supply." He rolled his eyes. "Could the little monster's story *be* any more convenient?"

"Oh, *please*," Darlene snapped. Beside her, Britt's head swung back and forth, like a spectator's at a tennis match. And just as unuseful.

"Excuse me," said Kyle, stunned by the unexpected disbelief. Swelk had specifically sought him out. Was he too close to, too influenced by, the little ET? "Maybe we can approach the problem another way. The most critical of Swelk's disclosures, whatever her motives, is the non-existence of the mothership. If we can corroborate *that*, if we can be sure there's 'only' the so-called F'thk vessel to handle, her story would be valuable."

Ryan shoved back his chair, its legs grating against the floor. "Come *on*, Kyle. Small telescopes see it. Radar shows it."

This time, Kyle had six copies of the images that had *almost* convinced Britt. He passed the prints around the table without explanation, letting the pictures tell their own story.

"Holy crap," reacted the CIA exec, her eyes bright. "The microwave and visible-light images don't match." Ryan, nodding in agreement, looked chagrined. The USAF Space Command could have made the same observation . . . weeks ago.

"Why haven't we seen a discrepancy before?" asked Darlene. "I know the mothership has been scanned by radar."

"Radar's ordinarily used to locate and identify an object, not to create a detailed image of it," Bauer explained. "What Kyle's showing us took a *lot* of computation. Why bother when it was so plainly visible to telescopes?"

Kyle rapped the table confidently. "The reason, my friend, is because our defector *said* there was no mothership. I'm saying the optical image is a hologram, and the featureless glob must be the echo of a radar buoy we can't see."

Darlene, for some reason, refused to catch his eye. What was going through her mind?



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She didn't give Kyle long to wonder. "You *know* I like Swelk. I trust her, too. That said, the stakes are too high to go with my gut. Like Reagan famously said of the Sovs and disarmament, I think we have to 'Trust, but verify.' "

Dar was the *last* person he'd expected to object. "What other explanation is there?"

She tipped her head, tugging a lock of hair in reflection. "I defer to every one of you about technology. Without knowing much about tech, though, I can concoct another explanation for what we're seeing. Kyle, you've explained before that the aliens have radar stealthing. Their satellites that upload recordings from the souvenir orbs, the satellites that we watched destroy that Russian rocket . . . *they* were stealthy."

"Go on," encouraged Britt.

"So imagine for a moment that Swelk's account isn't true. Whether she's purposefully lying or has been filled with disinformation, someone, in this scenario, wants us to believe her. They *want* us to mistakenly conclude that the mothership is fake." Darlene swept a hand grandiloquently over the pictures, her words tumbling out in a rush. "Couldn't they enable a stealth mode on their small craft? Then those smaller spaceships would be seen visually but not by radar. Isn't it at least possible that a real, physical mothership could use a stealth mode to prevent a true radar reflection *and*, whenever pinged, emit a synthesized signal that matches a featureless large blob? Wouldn't those stratagems also explain your observations?"

Scientist, general, and spy-master exchanged surprised glances. Erin Fitzhugh found her voice first. "If you ever get tired of working at State, there's a spot for you at the Agency."

Discussion continued—of Swelk's debriefings, of analyses of her salvaged equipment, of the international dangers posed by recent F'thk secretive whisperings—but the decision-making part of the meeting had ended. Whatever their opinion of Swelk, no one could be certain her story was true. There would be, for now, no disclosure to the Russians of her arrival and claims. Unwilling themselves to recommend a desperate attack on the F'thk ship, they dare not risk influencing the Russians to try.

Would they be ready to share, Kyle wondered, before a nuclear miscalculation obliterated them all?

## CHAPTER 21

Stinky *humphed* with satisfaction, leaning into the pushbroom that now served as his brush. Swelk groomed the swampbeast with long, smooth strokes, quietly pleased at the glossiness of his leathery skin. As Swelk worked, Smelly butted her head, first gently, then insistently, against her. "Your turn is. . . ."

Smelly's importuning was not simple impatience for her turn. Swelk plummeted, only then realizing they had all been suspended in mid-air. Stinky and Smelly shrank as she plunged, until only their fading fearful trumpeting remained. A recess of her brain noticed without explanation that the animals had not fallen.

She shuddered awake, intertwined digits rigid with fear. Bellows of unseen swampbeasts filled her mind. After forcing her digits to relax, to unlace, she tried but failed to stand. Visions of terrified swampbeasts overwhelmed her as she toppled, overcome by dizziness.

The nightmare did not surprise her—as much as she already loved the kittens, she missed the swampbeasts terribly. For the intense vertigo, however, she had no explanation.

Blackie and Stripes tumbled into the room, curious, perhaps, at the unexpected night-time noises from Swelk. She preferred to think they had come to console her. As the exile stroked their soft fur, she could not help but wonder: what is wrong with me?

It was not yet nine A.M., and four new pies were already cooling on the counter. The kitchen sink overflowed



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with mixing bowls, measuring cups, and utensils Kyle couldn't name. Hours before the Thanksgiving turkey would go into the oven, his seventy-year-old, gray-haired, stooping mother kept bustling.

Britt had more or less insisted he take a break. "Juggling knives blindfolded while riding a unicycle at the cliff's edge isn't instinctive behavior. A few months of it gets to most people. You should take some time away." To Kyle's rejoinder that he didn't exactly work for Britt any more, the politician had answered, "Then accept it as advice from a friend. You're fried. Go away for a few days." So here he was.

He'd offered to help Mom and been refused. He'd been shooed away when he started to wash dishes without asking. He'd proposed in vain that she sit for a while. With Mom it could've been a gender thing; he suggested that she save the potato peeling for Carol, Kyle's sister, whose family was due around noon. Nothing worked. Dad no longer tried; he was in the den reading the morning paper.

Fine. Kyle knew from whence came his own stubbornness gene. "Say, Mom, you mentioned a scrapbook? I thought I'd take a look." The *St. Cloud Times* was generally hard-pressed to find a local angle to national, let alone interstellar, affairs—they had covered Kyle's stint on the Galactic Commission with (to Kyle) embarrassing fervor. Mom couldn't get enough, and had the fat binder full of yellow-highlighted clippings to prove it. She'd brought it up repeatedly since his arrival last night, undeterred by all changes of subject. He *knew* she'd sit beside him on the parlor sofa whenever he picked up the scrapbook—and she did. As he leafed through it, he caught from the corner of his eye a self-satisfied smile. Maybe he wasn't the only one smug about an exercise in applied psychology.

Living as he did at the epicenter of events, none of the main articles were surprising. The sidebars were more diverting. Upstate Minnesota was not without its share of cranks—two had accosted him at the Minneapolis-St. Paul Airport, and the F'thk arrival was all the proof they needed. That no facts tied the newcomers to supposed UFO sightings and alien abductions seemed not to matter.

The important thing was that Mom was off her feet. He proceeded to read, slowly.

The 7-Eleven was mobbed. Not only was the convenience-store the closest approximation to an open grocery this Thanksgiving Day afternoon, but it was half-time in a tied Cowboys-Vikings game. Two men in line ahead of Kyle wore Vikings caps with soft stuffed horns. As inane NFL headgear went, he preferred Green Bay cheesehead hats. He kept the opinion to himself.

He looked randomly around the store, killing time. A full head of white hair, glimpsed in an overhead security mirror, caught his eye. Was the stranger watching Kyle? The man began studying his boots self-consciously as Kyle turned toward him. With a shrug, Kyle shuffled to face the checkout counter again. Thinking *this would be easier if I were Swelk*, he glanced over his shoulder at the dairy case's glass door. The somehow-familiar reflection peered back at him, the guy's expression a mix of brooding and expectation.

Hell, after many years out East, Kyle was a Redskins fan. He stepped out of line.

His observer was short, maybe five-six, with a gaunt face dominated by a hawk-like nose and piercing eyes. Up close the man's hair was a pale, pale blond, not unusual here in Outer Scandinavia. Dark brown, almost black eyes *with* that hair were. "Do we know each other?"

"Um, no." Uncomfortable grimace around the chewed butt of an extinguished cigar. "Anyway, you don't know me. I feel I know you, Dr. Gustafson."



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"Oh. Media coverage of the commission. My fifteen minutes of fame." It didn't explain why Kyle thought he *did* recognize this guy. "Sorry to have bothered you. I'm sure you have people to be with today."

As grief flooded the stranger's face, Kyle realized why the man looked so familiar.

"This will only take a few minutes," shouted Darlene over the keening of the air popper she'd brought from home. The loud whistle of the appliance's blower was soon punctuated by the rat-a-tat salvoes of exploding corn kernels. Melting butter sizzled in a pan on the stove top. Darlene warmed to the familiar sounds and scents. What could be more normal than movies and popcorn?

The venue was far from normal: Thanksgiving in a safehouse with a fugitive ET. The microwave-free kitchen seemed to predate the Eisenhower administration. Cooking involved a free-standing gas range that would be used that evening to reheat the CIA-provided holiday dinners. The agents would eat, in ones and twos, at their convenience. They were invariably polite to Darlene, but at the same time intensely clannish. If she bothered with a reheated meal, she figured it would be eaten with Swelk.

Swelk lacked holiday expectations, and in any event she would synthesize her own dinner. The usual feedstock for her bioconverter was pizza crusts and leftover takeout Chinese. So, as the popcorn popped, Darlene was "cooking" for, and feeling sorry for, only herself. Her folks, God bless them, were on a cruise. Fail to make it home for three years running, and suddenly there's an expectation. She couldn't say why she'd declined Kyle's invitation to Minnesota.

On second thought, she could: confusion over what, beside professional, her relationship with Kyle was supposed to be. Darlene wasn't seeing anyone at the moment, nor did she care to. Her last relationship, with a partner at a cut-throat DC law firm, had ended badly when he forgot how to leave the go-for-the-jugular attitude at the office. Not that a covert war against interstellar aliens and the approach of Armageddon put one in the mood for a social life. . . .

She had to laugh as Stripes sauntered into the kitchen from the hall. White markings around the kitten's eyes gave her an expression of permanent surprise. Cats for Swelk—sometimes Kyle's instincts were dead on. She valued Kyle as a colleague and thought they were becoming good friends. Unfortunately, his Gobi-dry humor and flirtation-impairedness had her at a loss about *his* intentions. Who knew what signal she'd have sent by going to meet his family? She'd think about sorting it out in a few months if civilization still existed.

Plastic popcorn bowl in one hand, a warm Diet Coke in the other, Darlene backed out of the kitchen, bumping the door open with a hip. "Ready to start . . ." she began. She turned to find Swelk splayed out on the dining-room floor, twitching. The din from the air popper had clearly obscured the thud of the ET hitting the planking. Nothing muffled the crashes of her bowl and soda can. "Swelk! What's wrong?" Two agents burst in from the hall as she spoke.

"I don't know." The computer took forever to translate. "I suddenly could not stand on all threes. The room was spinning around me." Swelk arose shakily, her second utterance put more quickly into English. "Whatever it was, it is going away."

The delayed translation was scary, bringing to mind slurred speech. Did Krulirim have strokes? "Is there anyone we should call?" That any human physician could treat the alien was implausible, but Darlene couldn't bear not acting.

"Yes." Sensor stalks bobbed in amusement, involuntary tremors marring the wry waggle with which Darlene had become familiar. "My doctor is unfortu-



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nately light years away." In the awkward silence that followed, tremors subsided into mere tics.

"Ms. Lyons?" asked an agent economically.

"I don't see what we can do," she told the guards. One shrugged. They left. "Swelk, maybe we should skip the movies." A whiff of buttered popcorn rose as she cleaned up the worst of her mess. One species' aroma was another's toxic fumes. "Does this smell bother you?"

"It was not the smell." The digits of an extremity clenched momentarily in Krulchukor negation. "Make more, if you would like. As to the movies, it would comfort me to watch."

"Okay to the movies. I'll skip the food."

At Swelk's command, a hologram formed over the dining-room table, projected by the alien computer. Indistinguishable Krulirim milled about a packed circular room, as writhing spiders scrolled around the bottom of the image. Opening credits? Captions for Swelk's benefit, Darlene decided, as the translator intoned, in a voice unlike what it used for Swelk, "The Reluctant Neighbor."

She watched from a slat-backed Shaker chair, rapt but unhappy. Fascination with the alien film was understandable. Ditto her unhappiness with Swelk's unexplained episode.

She *knew* she was overlooking something of extreme importance. But what?

The rolling pasture was bleak and windswept, its dormant grass brittle beneath Kyle's shoes. The flapping wings of a crow breaking cover made the only sound. Then it was gone, and stillness returned.

He was a good mile from pavement. How stupid was he to let embarrassment bring him here? Too late he'd realized why the man at the 7-Eleven looked so familiar: a press photo in Mom's scrapbook. Andrew Wheaton's wife and son had disappeared, and he blamed the F'thk. That the Galactics hadn't appeared for another two months seemed unimportant.

"The farm breaks even," said Wheaton finally. A weather-beaten red barn was just visible in the distance behind him, past a stand of pin oaks. "Most years. With my night job at the airport we made . . . I make . . . ends meet."

"Twin Cities?" asked Kyle.

"St. Cloud Regional. I'm a baggage handler." He tapped with a scuffed boot tip at a tuft of grass. "Bunches of pilots radioed in about an unidentified light that night. The tower people talked all about it, but radar didn't see nothing."

An evening star? Venus appeared in the evening sky that time of year. Ball lightning? A small plane whose radar transponder was out of order? Several things could explain a mystery light in the night sky.

"The house was empty when I got there." A gust of wind stirred the farmer's pale hair. "Tina's car was in the drive. House lights was on. Junior's sheets was rumpled, so he'd been to bed. Dinner dishes was only half-done. So they was home at around eight, same time the pilots seen the thing in the sky."

Kyle jammed his hands into his coat pockets. He felt sorry for the man, but how did that help? His body language must have conveyed those doubts.

"I drove home through snow. The only tire tracks at the house was from my truck. I found footprints, though. From boots, I mean. Their coats and boots were gone." Wheaton stared at a low area in the meadow. "They walked here, I think to check out the lights. They didn't come back."

"What did the police say?"

"Snow covered everything before the cops got here. They didn't believe me about the footprints. Said maybe a friend drove them away. Said maybe they left before the storm started, so that there'd be no tire traces under newer snow.

"They asked: did I beat them? Bas-


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tards. Changed their tune some when they couldn't find Tina and Junior nowhere. Now, they think I did it." He jerked his coat zipper up an inch. "Bastards," he repeated.

"It?"

"Think I killed 'em. Cops dug up a bunch of the farm. Didn't find nothing." A tear rolled down the farmer's cheek.

Jeez. Kyle didn't know how to respond. He studied the depression which Wheaton had indicated. Today was a day for *déjà vu*. First Andrew, and now the dip seemed familiar. Nothing grew here in November, but the dry grass in spots of the hollow was stunted and sparse. Kneeling for a closer examination, the ground's cold wicking through his jeans, the thinness of the grass was explained: the earth from which the few blades grew was compacted, like a dense clay. The word "clay" also teased his memory.

How these observation helped, if at all, eluded Kyle. All that he felt certain of, somehow, was that the despondent farmer had done no harm to his wife and child. "If you don't mind, I'll have the area checked out."

Wheaton nodded. He kept his face carefully composed, as though afraid to hope.

Walking back to his car and Andrew's pick-up, Kyle recalled what Andrew had bought at the 7-Eleven: a turkey TV dinner and a six-pack. He could do nothing about the lost family, but he *could* address that sad and solitary holiday meal. "I hope you'll join me at my folks' house for Thanksgiving dinner."

## CHAPTER 22

The blackened blotch that marked Swelk's landing site dominated the view eastward from Krieger Ridge. Kyle had paced out the scar, and it was fifty yards wide at its narrowest. The only visible irregularities at the opposite end of the valley were three reddish patches that more suggested than presented themselves. Grass didn't grow well in those spots, and the clay-tinted earth peeked through.

In the Midwest, where Kyle had grown up, soil was *black*. Years after settling in Virginia, its red soil sometimes still caught his eye. These particular red areas, which together defined an acute isosceles triangle, had lodged themselves in his subconscious: they marked the landing site of the second F'thk lifeboat, that had followed Swelk. The three landing skids had borne the entire weight of the lifeboat, tamping down the ground underneath.

Kyle tore his eyes away from the photographic blow-up of the valley near his home. The time for speculation was past. It was time instead to see if he were imagining things.

Hammond Matthews jotted numbers onto a whiteboard. His annual winter beard, begun at Thanksgiving, was almost neat. By Easter, when he'd next shave, he would look like a mountain man . . . except for the white socks and sandals. Past and present lab directors were alone in the eavesdropper-proof confines of the shielded radiometrics lab.

Matt finished with a John-Hancock-esque flourish. "The top number is a measurement: the weight of the charred remains of Swelk's lifeboat. Middle pair of numbers: upper and lower bounds of weight estimates for the F'thk lifeboat that followed her. The estimates derive from soil compression under the marks of the landing skids, just like you suggested. Measured wreckage weight falls nicely inside the bounds of that calculation, so the approximation method seems valid." Matt pantomimed a drum roll. "Last two numbers: the same range computation for the similarly configured compression marks in the pasture in Minnesota." He didn't bother stating the obvious: these numbers were *also* consistent with a landing by a F'thk lifeboat.

The result was only what Kyle had expected—and yet it was shocking in its implications. He crossed the room to the insulated carafe of coffee. Even a perco-



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lator or a hot-pot would interfere with the lab's sensitive instruments. He was less interested in a refill than the opportunity to face away from his collaborator and good friend. Need-to-know sucked.

"Kyle, buddy?"

"Yeah." He studied his cup.

"Compared to what we do for a living, tracing whose property your samples came from wasn't much of a challenge. Neither was running a Web search on the name Andrew Wheaton. Can you guess what I'd like to know?"

Kyle turned. "How a F'thk lifeboat could land in Minnesota two months before the mothership arrived. What the F'thk have to do with the Wheaton family disappearances. Why the F'thk would be snatching humans."

"Yes, to all of the above, although those questions are way beyond my pay grade." Matthews retrieved a paper scroll from a file-cabinet drawer, unrolling it across a desk. It was a world map, sprinkled with hand-drawn red circles. Most of the scribbles were in the US and Russia. "No, what I'm wondering is how many of these other UFO sightings in the past year also show evidence of F'thk presence."

With its window cracked to let out steam, the safehouse bathroom was freezing. Darlene showered quickly with the water turned to full heat. She ran out of hot water within minutes.

The bathroom mirror was covered with condensation when she got out. Unfortunately, the one outlet in the bedroom she'd adopted was nowhere near its mirror. Shivering in her robe, she used her hair dryer first to clear a spot on the befogged mirror and then on her hair. She gave up on the job as soon as she achieved non-sopping wet.

Hair damp and pulled back in a pony tail, she bounded down the stairs for a mug of hot tea to wrap her hands around. Guards were talking softly on the front porch as she rounded the corner to the kitchen.

Swelk was spread-eagled on the kitchen floor, her limbs quivering.

"Again? What happened?" Her only answer was the dipping of stalks: a shrug. Why the hell weren't the agents ever around when this happened? Darlene knelt beside the alien, all thoughts of the cold forgotten. Eventually, as the twitching subsided, Darlene helped Swelk back to her feet. "What can I do?"

"I was suddenly dizzy. I do not know why." Wobbly on two limbs, Swelk braced herself with the third against a cabinet. "What can be done? Nothing like this has ever happened to me."

"Are you eating enough? Would you know if something were missing from your diet?"

"My food is fine. At least my equipment tells me so." Swelk fell silent, and seemed to withdraw. "I do not know what is happening. When I sleep, I dream of falling. When awake, I sometimes do fall."

"I wish there was some way I could help."

Swelk pointed upwards. She could not get herself a drink without climbing onto the counter. It appeared she was too unsteady for the ascent. "If you would pour me a glass of water, and watch a movie with me, I would much appreciate it."

Inside what was, after all, a summer cabin, the howl of wind and the drumming of rain were loud. The storm, passing up Chesapeake Bay, was expected to become New England's first nor'easter of the season. No one had arrived at *this* crisis-team meeting by boat.

Whether because of the noise, or the inexplicable air of distraction from Fitzhugh and Bauer, Kyle found himself nearly shouting. "Guys, it's really quite clear-cut. We know from direct measurement what a Galactic lifeboat weighs. We know what indications it leaves behind at a landing site. There are *five* confirmed landing sites, each corresponding to an unexplained disappearance. The


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implication is that aliens kidnapped these people to figure out what makes us tick. What we're scared of. One more way to know how to push our buttons."

"Are all the sites in the US?" Britt polished his eyeglasses with his tie as he spoke.

"Yes, but that might be because we've only looked at suspected landings here. Scoping out prospects in Russia will take resources I don't have." Kyle looked pointedly at their CIA and DoD reps, but they avoided his gaze. Time again to suggest more information-sharing with the Russians? As he opened his mouth to propose it, Erin Fitzhugh's pager beeped.

"Hot shit!" yelled the CIA deputy director as she scanned the short text on the pager screen. Moments later, the general's pager burst into a short fanfare. Reading his own message, Ryan, too, broke into an out-of-character, ear-to-ear grin. They high-fived across the table.

"Good news?" asked Darlene dryly.

"Big time." Erin Fitzhugh interlaced her fingers and ostentatiously cracked her knuckles. "*Big* time. The Israeli air force just bombed the crap out of a hole deep in the Iranian desert."

Kyle's stomach lurched. Wasn't this just another step down the slippery slope to disaster? "War in the Middle East is somehow *good*? I thought our plan, such as it is, required keeping the visible tensions between us and the Russians."

"That's still the plan," said Bauer. "There's no chance of watching CNN out here, is there? Damn. Anyway, 'Hot shit,' as Erin so amusingly put it, is dead on. We were all but certain the Iranians had a surreptitious nuclear program. Our best evidence, though, was that they had only enough weapons-grade uranium for two or three bombs. There's radioactive fallout downwind of the airstrike."

"So Iran is now probably nuke-free," Darlene filled in the blank. "With Israel's nuclear capability the world's worst-kept secret, the Iranians are much more likely to behave."

"Game, set, and match," agreed Fitzhugh.

Fine, then, it was good news (presumably cryptically conveyed) . . . but only to the extent of extinguishing *one* of the fuses the aliens kept trying to light. And how many deaths had even this single victory cost? "It's the *Krulirim* we have to stop. The landings and kidnappings all predate the F'thk broadcast announcement and the appearance of the mothership. These landings and abductions before the arrival of the so-called F'thk . . . surely they substantiate Swelk's story."

Britt stood at a window, peering out over the bay. The storm was receding. "Backs it up, yes. Proves it, no. You'd like me to conclude that because the F'thk arrived before we saw the mothership that the mothership cannot be real.

"You can't certify that the mothership wasn't, for example, lurking behind the Moon where we couldn't see it. You can't know that the mothership didn't just arrive later than the F'thk, that the vessel we deal with wasn't a scout.

"The Israelis put out one fire for us. With good luck and good planning, we can douse a few more." Britt turned towards the table, hands clasped behind his back. "I can tell you for a fact the president will not sanction an action as desperate as an attack on starfaring aliens until he has absolute proof the mothership doesn't exist . . . or absolutely no alternative."

With *bad* luck, they'd all soon glow in the dark. Kyle took a deep breath. "Understood. I believe there is a way to determine, once and for all, whether the mothership is real. We'll have only one shot at the test, and—you won't like this—the experiment *must* involve the Russians."

As the silence stretched, he suddenly realized that Britt, Erin Fitzhugh, and Ryan Bauer were grinning. Britt gestured at Erin.

"Oh, we trust the Russians right now,"



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she said. "Iran is a Russian client, and guess who gave us the lead to locate the Iranian nuclear-weapons factory."

## CHAPTER 23

The galaxies were unimaginably distant, their violent, slow-motion collision unleashing equally unfathomable energies. Millions of years later, the tiniest fraction of that energy streamed past Earth. Ironically, after traveling so incredibly far, the X-rays produced by that intergalactic encounter were absorbed by Earth's thin skin of atmosphere.

"Your request surprised me, my friend." Sergei Denisovich Arbatov stood beside Kyle in the cluttered astronomic-studies lab at the University of Helsinki. Sergei's hairline had receded shockingly in a few months' time. Could stress do that? Some things hadn't changed: the twinkle in the Muscovite's eyes and, despite the onset of winter, his trademark deep tan. "NASA has several instruments capable of observing the object you selected. Your failure to comment why I would be interested also intrigued me." The personal delivery by the American ambassador of Kyle's letter might also have engendered some curiosity.

There was a time when research satellites were operated by large teams of technicians from gleaming control rooms arrayed with phalanxes of consoles. Such extravagance for mission control now applied mostly to manned space flights—of which there were none, with the shuttle fleet grounded and the Russians broke—and bad sci-fi movies. An entry-level workstation with Internet access to a steerable antenna sufficed. The PC on the dented wooden lab bench was, just barely, adequate.

Tarja Nurmi, the instrument controller there to assist them, half-sat, half-leaned on the lab stool in front of that PC. Her back was to Kyle and Sergei. Her tattered and too-large sweatshirt was incongruously emblazoned with a Virginia Tech seal. Her pale blonde hair, common enough in this corner of the world, brought Andrew Wheaton guiltily to mind. The grim confirmation Kyle could provide—that the site of his family's disappearance *had* seen an alien landing—would do Wheaton little obvious good, while possibly endangering Earth's underground resistance.

Focus, Kyle directed himself sternly.

The names the young astrophysicist had been given for her visitors were aliases. If she wondered why, in a world possessed of a ubiquitous Internet, those guests insisted on observing in person, she made no comment. Language differences didn't stop her—she and the Russian and French co-principal investigators for whom she usually toiled all communicated in English. Those co-PIs were ticked off and several time zones distant, fuming at the unexplained preemption by Rosaviacosmos of their long-scheduled viewings. Sergei, as science advisor to President Chernykov, had arranged the re-tasking of the Russian space agency's orbiting X-ray observatory.

Surely the Russian had analyzed Kyle's unexpected request before doing so. The American briefly inclined his head toward Tarja's back. *I must be discreet.* "Yes, we have X-ray instruments in orbit. None has this exact viewing angle just now." The need to use a Russian satellite was actually fortunate. It should make Sergei much less likely to question what—Kyle fervently hoped—they would soon see. He was not about to verbalize why exactly *now* was so important, or that the biggest supercomputer at Franklin Ridge had number-crunched for days to identify this not-soon-to-be-repeated opportunity. "Are we ready, Tarja?"

"We're locked on now." With casual grace, she moused open a new window. A scatterplot popped onto the PC monitor, colored dots richly strewn across a black background, the many hues representing X-ray frequencies invisible to the human eye. The small blinking square at the window's exact center enclosed the blazing dot that was tonight's target. In


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the lower-right corner, a frequency vs. energy histogram summarized the radiation from the crashing galaxies. In the lower left, a real-time clock counted in milliseconds.

A large circle dominated one side of the window, part glowing crescent and the rest a lightlessness interrupted by a faint dusting of pinpoints. "The big disk is the Moon, of course." The young Finn tapped the screen. "The crescent is what Earth sees right now of the sun-facing side. We're seeing directly reflected solar X-rays. What appears to be the dark side of the Moon is blockage by the Moon of the sky's X-ray background."

Sergei frowned. "Why are there *any* spots on the dark side?"

Tarja yawned and stretched before answering. Fair enough: it was 2:37 A.M. by local time. "Sorry. Those stray dots on the dark side come from the scattering of solar X-rays from all around the solar system. Reflections from planets and asteroids."

"Will the clock stay on-screen if you zoom in?" asked Kyle.

"It can." She yawned again. "Sorry." She keyed a new scale factor and the window was redrawn. The targeting square and the dot it encompassed lay near the dark edge of the Moon.

Kyle crouched over Tarja's shoulder. The clock display, reading out in Coordinated Universal Time, was scarcely a minute from the instant he'd memorized. Forbidding himself to blink, he watched the dot creep closer and closer to the Moon. A side of the targeting box kissed the limb of the Moon, slid over the Moon. Sergei, on his right, exhaled sharply seconds later as the multi-galactic dot abruptly winked out, eclipsed by the Moon.

"Get what you needed?" Stifling yet another yawn, she handed them diskettes containing the session's observational data.

Before the American could overcome his own sympathetic yawn, Sergei replied. "Yes, my young friend. We have." Tapping Kyle on the shoulder, the Russian added, "Perhaps it would be best if we took a walk."

The campus grounds were dark, deserted, and bitterly cold. The deserted aspect of those circumstances was good. "Interesting that you answered Tarja for me, Sergei." Kyle's breath hung in front of him.

Sergei hunched his shoulders against an icy gust. "You were very specific as to when a fairly unremarkable astronomical object must be observed. Such insistence, it makes one ponder."

The stars sparkled like diamonds. The crescent moon they had so recently "seen" by its X-ray reflection shone down with a cold white light. "Were your musings rewarded?"

"I had to wonder, as perhaps young Tarja would, were she more awake, why one would schedule an observation certain to be interrupted. Could it be, I asked myself, that I'm not here to see what my friend *said* he wanted to show me?" An eddy of snow swirled past them. "Was it only a coincidence that you wanted to look so near to the Moon?"

"Go on." Did Sergei *really* know, or was he bluffing?

"There is something important in the vicinity of the Moon."

Kyle scrunched his neck, in a vain attempt to shelter more of his face and head within his upturned collar. And he'd thought Minnesota was cold.

"Exactly on schedule, the edge of the Moon hid our celestial X-ray source. But *that* eclipse was not what you brought me to see, was it?" Sergei grasped Kyle's coat sleeve. "More interesting, I think, is that our observation went uninterrupted *until* the Moon blocked our view.

"It is time, *tovarishch*, to explain why you expected the Galactic mothership to be transparent to X-rays." The glaring political incorrectness of that Soviet "comrade" showed just how overwrought Sergei was. "And does such



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transparency mean, as I believe, that there is no mothership?"

## CHAPTER 24

Roosevelt and Churchill held several secret summits in the depths of World War II. Less often, both met with Stalin. It was assumed that the Axis Powers had spies in all the Allied capitals, but the leaders still managed to sneak away and meet.

Kyle searched for solace in that imperfectly remembered bit of history. Alas, the one war-time conference he knew by name was the infamous, arguably failed Yalta. He hoped that catastrophic encounter wasn't an omen.

He was one of a handful of Americans in the summit delegation. A Russian contingent of similar size was across the table. The table in question resided in a private estate an hour's drive outside Ankara. As far as the rest of the world knew, this was a gathering of oilmen to discuss new pipeline routes for Caspian Sea crude. The cover story excused secrecy amid tight security.

Also as far as rest of the world (and, hopefully, the aliens) knew, President Robeson and his senior advisors were on retreat at Camp David . . . but when Marine One, the presidential helicopter, had returned to its base in Quantico, Virginia, the summiteers were on board. A low-key motorcade that had to have made the Secret Service cringe took the entourage to the general-aviation section of Dulles International Airport outside Washington. Their Russian counterparts arrived in Turkey by equally circuitous, and, it was hoped, confidential means.

The room had been swept for bugs by the protection details of two presidents. Sergei, whom Kyle was glad but unsurprised to see, accompanied him on another inspection. This was one meeting most definitely *not* staged for hidden observers. Completing their rounds, they eyed the sumptuous buffet left by their absent host. Kyle hurried to his seat, pausing only to fill a mug with strong, muddy Turkish coffee. No time would be spent coddling the jet-lagged.

"Dmitri Pyetrovich, how are you?" began President Robeson. Dark bags beneath his eyes belied a light tone.

"Fine, fine." President Chernykov impatiently waved his interpreter to silence. A former KGB apparatchik, his English was excellent. "You, me, the bug-eyed monsters, we are all great. Is merely a vacation of old friends." The cigarette trembling in his hand underlined the sarcasm.

"I take your point, Dmitri. We cannot be out of the public eye for long, and we have much to do."

"I hope we can agree on something *to* do."

Kyle summarized America's findings, Sergei from time to time interjecting corroborative data from the Russian investigations. Kyle tried to be brief, but there were enough new players in the two delegations that much give and take was required. When he at last retook his chair, utterly drained, he was hopeful that the gist had been successfully conveyed.

The Galactic orbs, those supposed symbols of peace and unity so freely dispensed by the F'thk, were spying devices. The systematic destruction of the satellites each nation relied on for detecting ballistic missile launches, losses that gave credibility to the innuendoes spread by the aliens on their travels. The many peculiarities of the F'thk visitors. The anomalies of the mothership: none of the expected gamma radiation, its complete lack of detail when viewed with microwaves, its transparency to X-rays. Human disappearances at sites marked by the signs of a F'thk lifeboat landing—often months before the announced arrival of the aliens. And the *pièce de résistance*: the alien defector whose shocking explanation—"it's only a movie"—explained every known fact.

A movie intended to climax in the nuclear self-annihilation of Earth.

Chernykov's expression grew uglier and uglier. None of this could have been



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new to him, but the succinct totality was intense. "Damn these aliens. Damn them. I want to *strike*. Enough, I say, of science projects." He snarled something in Russian.

Gen. Mikhail Denisovich Markov, Chernykov's military advisor, sat ramrod straight in his chair, looking ill at ease in his civilian clothes. A jagged scar angled down his left cheek. He reddened at his president's words.

"Who speaks today about how we will destroy these evil creatures?" said the American translator. Something in the delivery suggested a serious toning down of Chernykov's comment.

A muttered Russian response. Chernykov cut off the translator. "My military feels we cannot attack. The once-proud Russian armed forces cower from a movie company on a rundown cargo ship."

Kyle's fingers dug into the padded arms of his chair. This was no time for macho crap. Britt might later tear him a new one, but Kyle had to speak. "This *movie company* has a starship at its disposal. They have a fusion reactor. I've seen their incredibly powerful masers—microwave-frequency lasers—destroy a space shuttle. We know they can fry satellites with X-ray lasers. Swelk, our defector, says the starship uses lasers to blast space junk. If they can vaporize objects hurtling at them at an appreciable fraction of light speed, do you think anything we launch at them can matter? We damn well *should* be afraid of attacking."

His words tumbled out, faster and faster. "Suppose we attack and do succeed? Will the fusion reactor blow up? Will the stardrive, about which we haven't a clue, explode? How big a crater will be made if that ship does go boom?"

Chernykov, his upper lip curled, studied faces turned ashen at Kyle's outburst. "I thought we had come here to prepare to *act*. They have blown up your shuttle *Atlantis*. They have cost each of us one of our finest submarines. Will you ask them, 'Please, go home now'?"

What of the five crew on that shuttle, or the *hundreds* on those subs? The never-distant image of the fireball above Cape Canaveral blossomed anew in Kyle's mind. How many million had to join them? A hand was suddenly squeezing Kyle's forearm. A warning from Britt . . .

"Dmitri." President Robeson's voice oozed calm reason. Kyle had learned over the past few months that the icy calm masked bottled anger. At whom this anger was directed was not obvious. "We concur on the need to act. That agreement leaves many questions. What are the aliens' vulnerabilities? How can we exploit such weaknesses? When and where can we strike?"

"This is better, Harold. Please tell me more."

"Gen. Bauer will explain, Dmitri."

Ryan went to the head of the table. "Dr. Gustafson raises pertinent points about the complexity of an attack on the aliens."

Chernykov frowned, but held his peace.

"The aliens' laser weapons would be a factor in any attack on the ship in flight. We must assume, as the good doctor suggests, that the ETs can acquire and destroy targets quickly. Our bombs and missiles would be nothing more than slow-moving space junk, easily killed."

A burst of Russian words stopped Bauer. The American translator rendered Markov's interruption. "Certainly, General, the starship must handle an occasional meteor. Would it handle many targets at once? Perhaps we can overwhelm their defense with a massed attack."

Bauer's forehead creased in thought.

This was madness—but could he raise *another* objection without being escorted from the room? Kyle began drumming on the table; as people looked his way in annoyance, he managed to catch Sergei's eye.



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"Quite ingenious," said Sergei, taking the hint. "Still, I hope you will indulge a physicist's view of the problem. Our fastest missiles go only a few kilometers per second. In CIA debriefing notes I have been shown, this Swelk claims their ships approach light speed. As you know, the speed of light is 300 *thousand* kilometers per second. That's how fast their ship overtakes space junk that's more or less stationary. At even one-hundredth that speed—a rate they surely exceed, or else a trip between even the closest stars would take centuries—they are accustomed to targets moving orders of magnitude faster than anything we can fire."

Britt leaned forward. "Dr. Arbatov, I don't follow you. You discuss the speed at which their ship travels. The issue relates to their ability to counter a massed attack by our missiles."

"Excuse me. I will make the point more directly. Imagine the alien starship overtaking a pebble in space at a thousand times the speed of our rockets. They must spot it, track it, shoot and destroy it, all in an instant. May not their defenses handle each slow Earth-fired missile, one by one by one, each with ease?" He smiled disarmingly at the American general. "Your fine navy has Aegis cruisers that can shoot down missiles traveling at hundreds of miles per hour. How many hang gliders must an assailant deploy to overwhelm an Aegis cruiser?"

Swelk came awake with a whimper, the world whirling around her. At least the spinning tended to stop after her eyes had been open for a while. Why could she not sleep soundly?

Guilt, loneliness, a fault in the bioconverter on which her life entirely depended . . . she had many theories. Perhaps confinement. Perhaps nothing more than the intermittent bonging of the angular ugliness that Darlene called a grandfather clock. A recess of Swelk's mind insisted it had recently heard four bongs.

Climbing shakily to an erect position, she began to prowl yet again what little she was allowed to experience of her adoptive world. The only humans around this late were her guards, outside on patrol or else in their trailer. Enough moonlight filtered through the curtains for her to forego Earth's unpleasant artificial illumination.

Four rooms upstairs, four down. Compared to her cabin on the *Consensus*, these chambers were luxuriously spacious, but there was no denying her situation. She had traded her own kind's open hostility for the less obvious, but no less real, distrust of the humans.

She was not allowed outside the building. What little news she was given of Earth's peril—due, she could not help reminding herself, to her own gullibility—was highly selective. Her many questions were deflected with polite evasions. And Kyle, the human to whom she had fled in hope and guilt and desperation, had disappeared without explanation.

Blackie stirred at the soft sounds of Swelk's approaching tread. The kitten stretched languorously, rubbing one eye with a forepaw. She tipped onto twos, using her lame limb to scoop up the yawning kitten. The kitten burrowed herself into the complicated three-way juncture between the limb's extremities and broke into a loud purr. That gentle rumble, pressed against the deformity that so defined Swelk, was ineffably soothing.

If only the humans' distrust could be so readily overcome.

Cooler heads prevailed and declared a recess. While most of the summiteers attacked the breakfast buffet, Britt and President Robeson disappeared into the estate's richly paneled, high-ceilinged library. When they reappeared, the president had an index card in his hand. After a final glance at his notes, Robeson cleared his throat.



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"The president," and Robeson nodded at Chernykov, "made a comment earlier that we did not pursue. That remark was something like, 'Can we ask them to go home?' It was an idea expressed in the heat of debate, and perhaps we did not give Dmitri Pyetrovich's observation the attention it deserved.

"We are all outraged at the deaths the aliens have caused. Having said that, revenge is seldom a wise basis for policy. Our prevailing interest, I submit, is the avoidance of future losses . . . most particularly prevention of a nuclear war. Our scientific folks," and he saluted Sergei and Kyle with a glass of ice water, "have done us a great service. It is time to focus our minds on 'the man behind the curtain.' May not these Krulirim illusionists, like the great and terrible Wizard of Oz, bow to reality? They have been found out!"

Explaining the simile to the Russians took longer than the whole speech. As that got sorted out, Kyle marveled anew at watching a master politician at work. Crediting Chernykov with wisdom for what had been biting sarcasm . . . what a slick way to let the Russian gracefully distance himself from suicidal attack plans. Not for the first time, Kyle wished he had absorbed a fraction of the people skills to which Washington had exposed him.

"I apologize, Mr. President, for my unfamiliar reference. Your mastery of English and of our culture are such that I sometimes forget where you are from." Robeson removed his glasses, peered through them at a window, then wiped them vigorously with his handkerchief. (A premeditated moment of quiet, Kyle suspected, for the Russian to take in the flattery.) "The point, I hope, remains valid. We have known for months the aliens' purpose: incitement to nuclear war. For all that time, if I may be allowed another theatrical figure of speech, we have been afraid not to be seen playing our parts. The aliens, we told ourselves, want to destroy us. The owners of that awe-inspiring mothership can certainly obliterate us if we did not cooperate. Our best theory for the curious indirection of the obvious alien hostility was fastidiousness: their consciences would be cleaner if, in the end, we blew ourselves up.

"But things have changed. Our understanding has changed, thanks to a courageous Krul from whom we now know what is truly going on, thanks to rigorous scientific research to verify what Swelk has told us. There is only the one spaceship that flits from country to country, stirring up trouble. They incite us to self-destruction not from any intent to work indirectly, but because only *self*-destruction serves their purposes.

"So I return to Dmitri Pyetrovich's insightful question." Robeson, who had been pacing, halted across the table from Chernykov. "If they are told their cinematic goal will not, and cannot, be achieved, may they *not* simply go home?"

The atmosphere in the conference room, all morning so gloomy and foreboding, suddenly changed. As only Nixon could have gone to China, only this American president could propose accepting their losses from the aliens and moving on.

Despite exhaustion, jet lag, and incredible pressures, Robeson cut an imposing figure. Kyle could not help but recall his amazing biography. Marine captain and decorated Vietnam vet. Crusading state's attorney, fearlessly pursuing organized-crime families in New Jersey. Trustbuster in the Department of Justice. Two-term senator with a passion for national-security policy. Still early in his first term as president, making headway fulfilling a campaign promise of military reform.

Yes, it was a speech that only Robeson could have made, and he had done so masterfully.

*Aw, crap!* thought Kyle. Here we go again.

* * *



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For fear of eavesdropping, all personal electronics had been left outside the conference room. Deprived of his PalmPilot and 'net access, Kyle couldn't hope to get the quotation exactly right—and it was probably by Anonymous, anyway. The essence of the line, in any event, was crystal clear. "Every complex problem has a solution that is simple, obvious . . . and wrong."

You haven't lived until the presidents of two nuclear powers scowl at you. But having done so, could you then live *long*?

Britt, with characteristic poise, asked only, "What's on your mind, Kyle?"

Here goes. "It's possible the Krulirim will go home if we ask. Before their arrival, they had no reason to wish Earth ill. That said, there's a small voice whispering in my ear."

He'd just seen a politician at work, flattering Chernykov. "One of my flaws, I freely admit, is the tendency to view everything through the lenses of science and logic. In my early attempts to influence government policy, when you first brought me to Washington, I relied too rigorously on logic. I also crashed and burned far more often than I succeeded. A very wise man"—okay, Britt, recognize yourself here!—"eventually got through to me. I now occasionally know enough to ask, 'Can the other guy afford to live with my logic?' What worries me at this moment is how unclear it is that the Krulirim can afford to just leave.

"To be brief, I wonder . . . will Swelk's former shipmates accept the risk that what they attempted here will remain secret? Is that a gamble they can afford to take?"

Doubts were appearing on faces around the table, including, he was relieved to see, on the faces of both presidents.

"I'm trying to imagine how the conspirators may see their situation. Must they not be asking themselves: will we ever be held to account for our actions? What if another Krulchukor ship were to discover Earth? If humanity refuses to obliterate itself, how soon until Earth's starships are visiting our worlds?

"What if humans and other Krulirim do meet? Our aliens killed the crew of the *Atlantis*. They've presumably killed all the people they kidnapped, before their splashy public arrival, to better understand us. They're responsible for yet more deaths, beginning with the submarine catastrophe. We have film of their ship at sites across our planet. We have by now millions of the orbs and a wrecked lifeboat from their ship: technology whose origin they can't refute. In short, the plotters can hardly deny trying to stampede us to self-genocide."

"Even if we do nuke each other, some records may survive." Britt spoke with his eyes shut, deep in thought. "And survivors may still speak with future visitors. And that means. . . ."

". . . and that means," completed Kyle, "there's a very real risk—whether we blow ourselves up or not—that the ETs planned all along to utterly obliterate humanity before leaving our solar system."

"Depend on it, sir," Samuel Johnson is said to have remarked, "when a man knows he is to be hanged in a fortnight, it concentrates his mind wonderfully." The summiteers outside Ankara, eye-to-eye with the extinction of humanity, found their attention wholly focused. That convergence gave birth, at last, to a terrifying plan possessed of but a single virtue—no one saw any reason why the plan was *necessarily* doomed to failure.

Which wasn't to say a failure wasn't likely.

Attempting to destroy the starship was too risky. Ignoring the starship and hoping it would depart in peace was likewise too risky. And that left . . . capture.

Commandos would strike the next time the starship visited a Russian or an American city. ■

*To be continued!*



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# THE REFERENCE LIBRARY Tom Easton

**Tomorrow Now: Envisioning the Next Fifty Years**, Bruce Sterling, Random House, $24.95, 324 + xxiv pp. (ISBN: 0-679-46322-4).

**Exploring the Matrix: Visions of the Cyber Future**, Karen Haber, ed., St. Martin's, $24.95, 271 pp. (ISBN: 0-312-31358-6).

**Bitter Waters**, Wen Spencer, ROC, $6.99, 308 pp. (ISBN: 0-451459229).

**For Love and Glory**, Poul Anderson, TOR, $24.95, 300 pp. (ISBN: 0-312-87449-9).

**Memory**, Linda Nagata, TOR, $26.95, 416 pp. (ISBN: 0-312-87721-8).

**Tomorrow Happens**, David Brin, NESFA Press (P.O. Box 809, Framingham, MA 01701), $25, 223 pp. (ISBN: 1-886778-43-4).

**Where Is Everybody? Fifty Solutions to the Fermi Paradox and the Problem of Extraterrestrial Life**, Stephen Webb, Copernicus Books, $27.50, 288 + xii pp. (ISBN: 0-387-95501-1).

Science fiction is a curious field. Long ago, writers and readers both thought it rather prophetic, in intent if not in practice. *Good* SF was at least supposed to try to predict the future, and everyone involved felt very good when it came close. *Astounding/Analog* has long preened itself for the Cleve Cartmill story that described the A-bomb so closely that the FBI came looking for spies. My own favorite is Charles Ott's "The Astrological Engine," a September 1977 *Analog* story from the days when hand-held calculators were still new, that concerned a calculator that hung around your neck and—at the push of a button—gave you your personal up-to-the-second horoscope. Six months later, just such a calculator appeared on the market.

So sometimes SF writers get to call themselves futurists. I was once invited to a corporate brainstorming session in that guise myself, and certain journalists periodically call for my "futurist" thoughts. Jerry Pournelle once had the ear of a national politician. And . . .

And then there's Bruce Sterling, who says, "In normal circumstances, I'm not the sober, serious futurist that you will see in [**Tomorrow Now: Envisioning the Next Fifty Years**]. This is me as a full-blown pundit, a brow-wrinkled journalist who attends the Davos Forum, networks with Californian corporate forecasters, and mourns the tragic loss of the Congressional Office of Technology Assessment. Most of the time I really don't care to work that hard. Because I'm a science fiction writer."

And a good one too, well deserving the "visionary" label the flap copy bestows on him. Yet he has also committed journalism, and his last nonfiction book, *The Hacker Crackdown*, was an excellent portrayal of the dawn of the cyber culture. Now he turns to the next half century of our—or our children's—lives, noting that "Futurism doesn't mean predicting an awesome wonder; rather it means recognizing and describing a small apparent oddity that is destined to become a great commonplace." He frames his effort with a well-known Shakespearean quotation: "All the world's a stage, and all the men and



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women merely players; . . . And one man in his time plays many parts . . . the infant . . . school-boy . . . lover . . . soldier . . . justice . . . pantaloon . . . Last scene of all, that ends this strange eventful history, is second childishness and mere oblivion . . ."

Infancy is biotech, not in the sense of genetically tweaked super-babies but in the sense of appliances—gengineered bacteria that do all sorts of marvelous things both inside and outside you. Studenthood is the information economy, computers, networks, robots, volatile economies, and lifelong learning. The lover has relationships with new-industrial blobjects. The soldier is the New World Disorder, terror, and fear. The justice is the new politics, greased by the Web so that "moral panic is the signature political motif." The pantaloon is money, business, the wealth to be gained from information. Oblivion is the end of all, the potential for slaughter and plague and environmental disaster and the inevitability of a new age dawning, whether we jump or are shoved.

Sound interesting? Sterling is longer on the poetics of it all, the meaning and feeling, than on specifics, but anyone who tries to emphasize the latter, I think, is doomed to failure. Sterling thus has a fairly reasonable chance of being able to say "I told you so!" in a few decades. And he'll have done so very readably.

Recommended.

Bruce Sterling also has the lead essay (after the introduction by Pat Cadigan) in **Exploring the Matrix: Visions of the Cyber Future**. The book is riding the wave of a popular movie and its sequels, but that's okay. Cadigan starts things off by claiming that despite the science fiction connection and the blockbuster commercial $ucce$$, there's some serious intellectual discourse here. Then Sterling tells us that the heart of the film's appeal ain't the brain, it's the heart: "You can't be dead, because I love you." Kiss the tire-mushed kitten, and it will rise to purr again! Quick segue to Stephen Baxter, who stresses some of the logical and scientific difficulties in positing a perfect simulation for everyone to live in, and before long, there's Mike Resnick saying the new AIs aren't going to enslave us, they'll worship us, since we'll be quite demonstrably their creators. John Shirley chimes in too, as do Paul Di Filippo, Walter Jon Williams, Ian Watson, Joe Haldeman, David Brin, Alan Dean Foster, Kathleen Ann Goonan, James Patrick Kelly, and a few more, most of whom have written in one way or another about the future of AI.

Interpretations and riffs, criticism and praise, pop-culture film theory and gosh-wow pseudo-philosophy (could we be living in a matrix reality right now and not even know it?). Just the thing if you don't like to think of yourself as giving in to mindless entertainment on the big screen. Take a copy of this book with you when you go to the theater, and everyone who notices will know that you're into that intellectual discourse thing.

Sorry, folks. Sometimes I can't resist the urge to try to be cute. On a more serious note, the book was planned for release at the same time as the first sequel, *The Matrix: Reloaded*. That will be old news by the time you read this, but there's another sequel on the way, so the book works as part of the hype for that too. Unfortunately, to SF readers, there really isn't much here besides the hype; we've seen it all before. Non-SF readers who loved the movies and grabbed the book because of that will discover a great many ideas they've never heard of before. (Where have they been?!)

Oh, well. Maybe they'll become SF readers.

The third installment in Wen Spencer's Ukiah Oregon series—**Bitter Waters**—may be the best one yet.



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The back-story is that centuries ago, the alien Ontogard arrived on Earth, planning to infect local lifeforms and replace their cells with their own. The result of such an infection is a "Get." This is the perfect disguise for an invader. But among the Ontogard was a mutant rebel, Prime. He sabotaged the mission, killing most of the invaders. Before he died himself, he infected a local wolf who became Coyote and in due time infected enough humans to form the Pack, dedicated to warring against Hex, the surviving standard-issue Ontogard villain, and his numerous evil Gets. He also sired on a local woman of the Cayuse tribe our hero, Ukiah Oregon. In *Alien Taste*, we learned that Ukiah had been a wolf child until caught in a trap and adopted, that he had the ability to detect and analyze DNA the way we might a pungent odor, that when he is injured, lost blood or bits of flesh turn into small animals, and that he can recover from thoroughly mortal wounds. He also doesn't remember his origins, since memories run away with lost blood or flesh. He recovered some long-lost memories in *Tainted Trail*, when he and his mentor/partner, Max Bennett, took their PI business, specializing in tracking missing persons, to Oregon.

Now Hex's Ontogard villains are in retreat, greatly reduced in number. Ukiah is back in Pittsburgh, quite happy to see his son Kittaning (remember those small animals), and the Pack is in the neighborhood, keeping watch. But someone is kidnapping babies, an agent of Homeland Security has questions about a cult whose members carry pictures of Ukiah and Kittaning, and the babies are turning up dead.

Agent Hutchinson is scary because of his source, but he seems a nice enough guy and he's got his own agenda—he lost his fiancé to the cult. Ukiah and Max are sympathetic but puzzled, until . . .

Who's that at the door? Just a man with a gun, dear. And yes, that's Ukiah on the floor, bleeding mice. Kittaning is gone.

And the hunt is on. Ukiah doesn't take long to come back from the dead once more, and as soon as the kidnappers send a ransom note with a caterpillar that used to be Kittaning's finger, Our Hero can start tracking, right to the cult's doorstep and a frightening discovery—the cult is using an Ontogard bioweapon as an aphrodisiac.

A bit of detective work discovers that the Ontogard once stashed secret bioweapons in a high-security storage facility. Those weapons are now gone, and the case is no longer just about Kittaning. The fate of humanity is at stake, and after a couple of dramatic chase scenes and major explosions, it still is.

Spencer has at least one more installment to go, and she just keeps getting better.

Poul Anderson leads into **For Love and Glory** by saying that in 1990 and 1991, he wrote a pair of stories for the "Isaac's Universe" series. In due time, he decided he wanted to file off the serial numbers, rename the characters, the places, and even the alien species, keeping the originals as two episodes in a novel about several "spacefaring species, who come upon relics of unknown predecessors."

That seems a pretty thin description, so let's meet the characters. Lissa is a human woman from Asborg, daughter of a wealthy, powerful family, who hies off on research expeditions to places like Jonna. Her companion is Karl, her name for a tyrannosaurian alien who speaks through a voder. On Jonna, they spot an anomaly and rush to investigate, only to find Hebo, a centuries-old human male, and Dzesi, a felinoid alien, sitting on top of a Forerunner artifact that is actually working. Not that they can tell what it's doing . . . It certainly doesn't seem to be interested in helping Hebo rein in his grabbier impulses.

So Hebo gets his finder's fee and goes to Earth for a memory-scrub. Lissa re-



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turns to Asborg, until Orichalc, defector from the ophidian Susaians, shows up with word of something both mysterious and BIG developing way out yonder. For his help he wishes only a bit of real estate for his coreligionists, who are cruelly persecuted back home.

The mystery turns out to be a pair of black holes on collision course, and Lissa and her colleagues must negotiate with some rather prickly Susaians before they can intrude on the scene.

In due time, Hebo resurfaces, presents an audacious proposal on slim evidence, and nearly provokes a war before discovering some surprising truths about Forerunners, Earth, and even romance. Anderson is as always competent and readable, and if this lacks the verve of his past work, it remains well above much else being published today.

It is a sad thought that if Anderson were still alive, he might be working on a sequel.

In **Memory**, Linda Nagata takes nanotechnology in new and quite interesting directions.

At least, I *think* it's nanotech. The world of the tale is cursed not with the infamous "gray goo" problem, but with "the silver," which rises from the ground at night like fog. If it touches a human (or "player"—*vide* Shakespeare, perhaps), that human vanishes. So do buildings, and even landscapes. But the silver also leaves "follies" behind—ruins, buildings, even cities, which may be dreams of the goddess, or the memory of the world, of a past that is many thousands of years deep. People live in "temples" protected by "kobolds," devices that grow in certain patches of soil, somehow spawned by the silver. The silver also affects the people, for they are quite literally reborn, not with memories of past lives, but definitely with stores of knowledge gained in past lives, which need only be awakened by exposure. And each has but one true lover, who may be half a world away. Many perforce live out their lives without a mate, at least until they can be reborn again.

Does this sound like an intriguing place to live? I think so, for despite its obvious hazards, it has charm and mystery in plenty. Now meet Jubilee. She is only ten when her older brother Jolly is eaten by the silver. A few years later, she hears of her lover in a land far away. A little later, on a night when the silver is rising and Jubilee is watching from the wall of her home temple, a stranger emerges unharmed from the silver and asks after her brother, as if Jolly is not dead, but merely lost. He also says he is Jolly's father now, as if Jubilee's father is now dead.

And so he is, eaten by the silver like his son.

Mysteries indeed. It is supposed to be impossible to pass through the silver unscathed—though there *are* tales out of legend. Jubilee enters the market (a sort of cyberspace) and learns that her stranger has been seen before and even has a name, Kaphiri. Before long she is on a quest for answers that will bring her face to face with the flawed history of her world, with a villain who wants nothing more than the end of all, and with a destiny that has awaited her for many lives.

Jubilee is an appealing character, and her world needs her desperately. But she has needs too, and it is a sad moment for the reader when it becomes clear that those needs must go unmet.

As usual, Nagata gives us an excellent read. Look for this one on award ballots.

The guest of honor at Boskone 40 last February was David Brin. I hadn't seen him since the early 80s, when he and I and David Gerrold were invited to Miami to brainstorm an "environmental Star Trek" show for the PBS station there. Nothing came of it, but we had a good time, and Boskone was kind enough to give David and me a chance to talk about the incident before an audience. It



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was interesting to see how well it all fit into David's writings since then, for environmental concerns are very much at the center of his thinking. Of course, his thinking ranges quite far from that center too! Think of *The Transparent Society* (reviewed here in December 1999), in which he argued that the battle to preserve our privacy is threatened by increasing powers of surveillance, and our best defense may be reciprocal surveillance, or transparency.

In **Tomorrow Happens**, the collection NESFA published in honor of his guest-of-honor-ship, Brin displays the breadth of his thinking in twenty essays and short stories, all well worth the reading. As Vernor Vinge says in the introduction, "There are very few issues that escape David's advocatorial interest. Many of his ideas are in the area of sociobiology, how we may harness the beasts within to be engines for good. Often his ideas are couched in flamboyant and colorful terms [and] contain sidewise thinking that just might make the world a better place."

Which, of course, has a good deal to do with why he was invited to Miami.

Why me is a different question.

The Fermi Paradox is simply stated: If the Universe is full of intelligent species, why haven't they shown up yet? The idea is that at least some of those species should have been around for quite a long time, and even without faster-than-light travel, they have had plenty of time to spread.

So why haven't they shown up? Are we in fact alone? Or first? Are the conditions that lead to life and intelligence rare? Are there aliens living in disguise amongst us? Or are we quarantined? Reservationed? Zooed? Or maybe there's nobody there at all—not even us! (Sure, that could be it—if we are just simulations in some cosmic computer.)

In **Where Is Everybody? Fifty Solutions to the Fermi Paradox and the Problem of Extraterrestrial Life**, physicist Stephen Webb describes Fermi and his paradox in more detail, describes the basic ideas behind the Search for Extraterrestrial Intelligence (SETI), and lays out a variety of answers that have been suggested—most seriously, some a bit tongue-in-cheek—for why the search has not succeeded. He doesn't neglect ideas donated by the SF community, such as Vernor Vinge's Singularity and Fred Saberhagen's Berserkers. Nor does he neglect to offer his own rather bleak opinion, based on the "one gleaming, hard fact in the whole debate: we have not been visited by [extraterrestrial civilizations], nor have we heard from them." With just this one fact to work with, our biases have a great deal of room to work with, and in that work a great many obstacles to the development of a suitably intelligent species have been identified. It may, he says, be very unlikely that any species clears all the hurdles. It may even be so unlikely that only one species has done it.

So far. The Universe has a lot of its history ahead. And now that we're here, and developing technologies such as genetic engineering, it may not be very long before we are no longer alone. David Brin called this process "Uplift" and got a long series of award-winning novels out of it (though it was the aliens who were doing most of the uplifting). Such a thought could have permitted Webb to end his book on a more positive (uplifting?) note. Instead, he noted that it would be a shame if we did ourselves in, for then "it could be a long, long time before a creature from another species looks up at its planet's night sky and asks, 'Where *is* everybody?'"

In November 2002, I mentioned the Starman Series by "Michael D. Cooper," the team of David Baumann, Jon Cooper, and Mike Dodd. These three gentlemen had waxed nostalgic for the Good Old Days of Tom Swift, Dig Allen, and other boy's-SF-adventure series novels of



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half a century ago, in which the villains were capital-E-evil and the heroes were clean-cut, clean-mouthed, and clever, and decided to do something about it. Thus was born the Starman Series, which after the review appeared the authors informed me now runs to five books ($15 each for the first four and $35 for the fifth, *The Lost Race of Mars*) and a fanzine. I find there are also a fair number of mentions on the Web, including appeals to the SciFi channel to turn them into a show!

Last time, I called the series "good quaint nostalgic fun and a labor of love to boot." It still is, but the books may be hard to find. The series web site (www.starmanseries.com) is a good place to start.■

## IN TIMES TO COME

Our lead novelette for November, with a dizzying cover by Michael Carroll, is THE TRELLIS, by Larry Niven and Brenda Cooper. As our species learns new science and develops new technology, it tends to build new kinds of artifacts, some of them quite literally rising to new heights. At first glance this one may seem a bit familiar, but Niven and Cooper have given it (no pun intended) quite a novel twist. And, of course, building new things leads to new ways to get into trouble—which in turn creates a need to invent new ways to get *out* of trouble!

We'll also have what is very likely the last science fiction story by Lloyd Biggle, Jr.; something that *might* be considered seasonal by Ron Collins (with a schedule like ours, there's always the dilemma of which issue is appropriate: the one whose cover date is close to the event, or the one that actually *appears* close to the event!); and stories by Pete D. Manison and Kathy Oltion. Plus, of course, Part 3 of Edward M. Lerner's *Moonstruck*. Finally, the prolific and versatile Richard A. Lovett provides our science fact article, on "Moving Beyond Life As We Know It," an updated survey of how the emerging science of astrobiology is changing our view of where and how life might occur.



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# BRASS TACKS

Dear Stan,

I guess there are some jokes that should just not be attempted. Tom Easton's generous review of my *Speaking of the Fantastic* in your March issue is correct when it mentions that there are some errors in the name listings on the cover and table of contents of the book (though the *advantage* of print-on-demand is that only about 50 copies got out like that, and the errors are being corrected), but he is wrong to say that the book "trails off into alphanumeric gibberish on p. 18." No, at that point Terry Bisson, in late 1999, explains that he is writing an article "debunking the Y2K myth," which is due 11/15/99 and scheduled to be published 2/15/0- and then a string of gibberish follows. This, of course, is a joke, and just about every reviewer so far has failed to get it. If it proves too subtle even in such a technically savvy magazine as *Analog*, then I admit it should not have been attempted.

Darrell Schweitzer

Dear Stanley,

[Regarding the April fact article,] Ben Bova's N value may be right, but he makes the same error as the thinkers he criticizes: he assumes that the issue can be decided by argumentation, which is vulnerable to facts.

I talked with Isaac about SETI more than once. In fact, some of his ideas form the basis of *The Killing Star* (a 1995 novel I wrote with Dr. Charles Pellegrino). We may easily miss other civilizations in time. More than enough time exists in the life and death of suns, past and future, for this to happen. Ben doesn't seem to mention other galaxies. And even if billions of years from now we are still alone, that won't prove anything, since we can't search all of space and time, or the future.

I think the great hubris of humankind may very well be the hope that we are an only child. I have often behaved that way, as first born, even though I have a sibling. Now someone can prove or disprove my statement, because the means exist. But no one would try to argue it, absent the facts.

I wouldn't try to argue either side of the SETI issue. You can't prove negatives, but the positive may take longer than we are likely to live. Also, a legitimate scientific theory is defined as one that resists disproof and makes testable predictions—that it's always a horserace. Specifically, we can at least imagine the circumstances under which it would be confirmed. Ben's view is legitimate, but it too requires more than a lack of proof, and must not ask us to prove a negative.

The trouble is that either side of this debate may be right, because, until reality intervenes, and slays the beautiful theory, either side can fall back from any purely argumentative objection, shift its ground, and get whatever conclusion it wishes.

When this happens, logicians smile. It's a well-known logical seesaw in the history and logic of science. Nagel features it in his introduction to the subject—as a prime error.

And then there Clarke's First Law.

Strangely, Ben's argument makes it



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more likely that Earth was seeded in the past, by a single source.

Oh, Isaac told me that he made it a human future in the Foundation series because psychohistory wouldn't work on aliens (they'd have their own) or on AIs. See my story "Foundation's Conscience" in *Foundation's Friends*.

And, of course, John Campbell disliked humans losing out to aliens; but he published "Firewater" by William Tenn nevertheless.

Thanks, Ben, for helping me get my thoughts together on this once more.

I think there's an alien species out there called "The Ben"—Ben Bova is trying to hide this fact, as their observer here on Earth, as his article proves.

Therefore "The Ben" exist.

George Zebrowski

Dear Dr. Schmidt:

Ben Bova may well be correct to say "there are no intelligent aliens out among the stars" ("Isaac Was Right: N Equals One," *Analog*, April 2003), but his reasoning is unsound.

Bova adduces bacteria as a counterexample to Robert Zubrin's statement that the history of life on Earth shows a "continuous tendency toward development of greater complexity, activity and intelligence." In fact, Zubrin's statement is entirely true of multicellular life. That bacteria have in some sense marked time while multicellular life has gotten smarter and smarter, over the last 500 million years, is irrelevant.

Bova talks about intelligence as though it were a light switch, either on or off; for example, he describes dinosaurs as being "without intelligence." In reality, it is a continuum: vertebrates are smarter than invertebrates; mammals are smarter than other vertebrates; primates are smarter than other mammals; members of genus Homo are smarter than other primates; members of our species are smarter than members of other (extinct) species of genus Homo.

Argument from authority is questionable on its face, especially when the authority Bova calls on is Stephen Jay Gould. For ideological reasons, Gould emphasized the chance and accidental aspects of evolution, slighting evolution as a discovery process; that is to say, slighting natural selection itself. (And thereby giving much ammunition to creationists, to his great frustration.) As Darwin conceived it, natural selection operates on hereditary differences between members of a species, with the better adapted members leaving more offspring. For Gould, the idea of hereditary differences of this kind implies that there may be significant hereditary differences between human beings, a possibility he could not accept.

My own view? High intelligence has arisen many times in our galaxy but has never made it out of its home stellar system before going extinct. Its Nemesis: a nut with a test tube.

Taras Wolansky
Kerhonkson, NY

*The author replies. . . .*

The point of my article is that we have been laboring under the delusion that intelligence is the ultimate achievement of life. There is no evidence that this is so. Intelligence is an adaptation that has proven very useful to our species, but many other species, from bacteria to ants to dinosaurs to the three-eyed tuatara of New Zealand have gotten along quite successfully for tens and even hundreds of millions of years without a human level of intelligence. The available evidence, including the Great Silence that bedevils SETI, points to the conclusion that intelligence is vanishingly rare and far from inevitable. Wise up, people! Face the facts.

Ben Bova

Dear Stan,

I enjoy *Analog*, even—or especially—when I disagree with you. This time I had to say my two cents' worth.



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I agree that splitting infinitives occasionally has uses. I suspect that you, like so many of us, have studied Strunk and White's *Elements of Style*. I still refer my students back to the "little book" for help with their writing. It states that split infinitives have been used since the fourteenth century. It also cautions us to avoid them unless we want to stress the modifier.

Forbid, by definition, carries the absolute intent. Additional stress on the modifier is not needed. "To absolutely forbid" is repetitive. It's like saying a "lethal killing" or a "frozen icicle." Strunk's rule, "Omit Needless Words," applies. The best construction is, "They tried to forbid split infinitives." That sentence is shorter and more vigorous than either of those provided by you and Mr. Killian.

Christopher M. Easton, Ph.D.
Department of Biology
SUNY College at Potsdam
Potsdam, NY
eastoncm@potsdam.edu

*No, it's not repetitive. There are many real-world examples of rules that forbid doing something* except *under specified conditions. Adding "absolutely" in my example makes clear that no exceptions are to be allowed—which, in the language as actually spoken, is* not *clear without it.*

Dear Stan,

I believe the question you meant to ask was, "Why are you waiting?" Unfortunately, the question you meant doesn't support your position.

I hope that in the future, you'll do what you can to encourage proper communication. Who knows? Maybe you'll inspire somebody to overcome his "grammar-challenged" status that is often a result of inadequate education.

L. M. Jennings
Kirtland, OH

*No, the question I meant to ask was, "What are you waiting for?" You're right that some speakers carelessly use that construction to mean what you said, but others use it specifically and deliberately to mean, "What event [e.g., a conductor's cue, a light signal, or a temperature reaching a critical level] will tell you it's time to act?*

*And I will indeed do what I can to encourage proper communication, just as I have done in the past. This discussion is one example.* ■

Conservative, n. A statesman who is enamored of existing evils, as distinguished from a liberal, who wishes to replace them with others.

—Ambrose Bierce

Politics is the art of looking for trouble, finding it, misdiagnosing it, and misapplying the wrong remedies.

—Groucho Marx



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# UPCOMING EVENTS Anthony Lewis

**26–28 September 2003**
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**10–12 October 2003**
ALBACON (NY Capitol area SF conference) at Ramada Inn & Conference Center, Schenectady, NY. Guest of Honor: Lois McMaster Bujold. Artist Guest of Honor: Allen Koszowski. Fan Guest of Honor: Oz Fontecchio. Filking Guest of Honor: Leslie Fish. Registration: $35 until 13 September 2003, $45 at the door. Info: Albacon, Post Office Box 2085, Albany NY 12220-0085. www.albacon.org

**30 October–2 November 2003**
WORLD FANTASY CONVENTION 2003 at Hyatt Regency Washington on Capitol Hill, Washington, DC. Guests of Honor: Brian Lumley, Jack Williamson. Publisher Guest of Honor: W. Paul Ganley. MC: Douglas E. Winter. Registration: $120 until 31 July 2003, $35 supporting. Info: WFC 2003, 7113 Wayne Drive, Annandale VA 22003-1734, info@worldfantasy 2003.org, www.worldfantasy2003.org.

**8 November 2003**
CON*CEPT 2003 (Montreal SF & Fantasy Conference) at Days Inn Hotel Downtown Montreal. Anglophone Media Guest of Honor: Claudia Christian. Francophone Media Guest of Honor: Frédéric Ouellet. Artist Guest of Honor: Heidi Taillefer. Writer Guest of Honor: Dave Duncan. Registration: CDN18 until 15 September 2003, CDN25 at the door. Info: Post Office Box 1186, Place du Parc, Montreal, Quebec H2X 4A7. cathypl@sympatico.ca www.monsffa/concept2003.html or www.monsffa/concept2003f.html

**2–6 September 2004**
NOREASCON 4 (62nd World Science Fiction Convention) at Sheraton Boston, Marriott, and Hynes Convention Center, Boston, Massachusetts. Guests of Honor: William Tenn, Terry Pratchett, Jack Speer, Peter Weston. Registration: Attending USD160, Supporting USD35, Child USD105. This is the SF universe's annual get-together. Professionals and readers from all over the world will be in attendance. Talks, panels, films, fancy dress competition—the works. Info: Noreascon 4, Post Office Box 1010, Framingham, MA 01701. FAX: +1.617.776.3243. info@noreascon.org www.noreascon4.org

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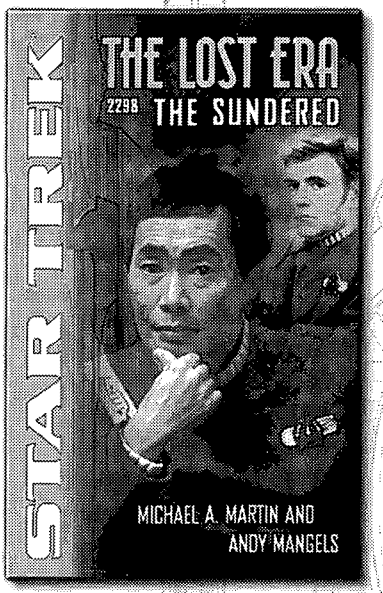


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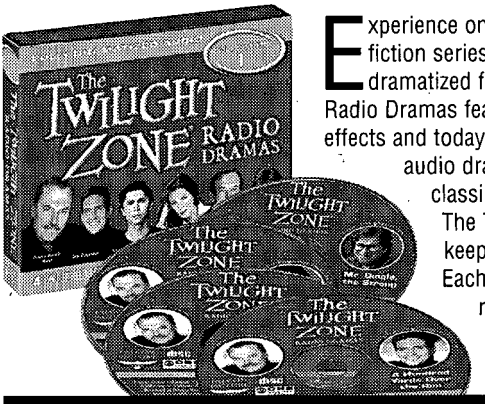


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